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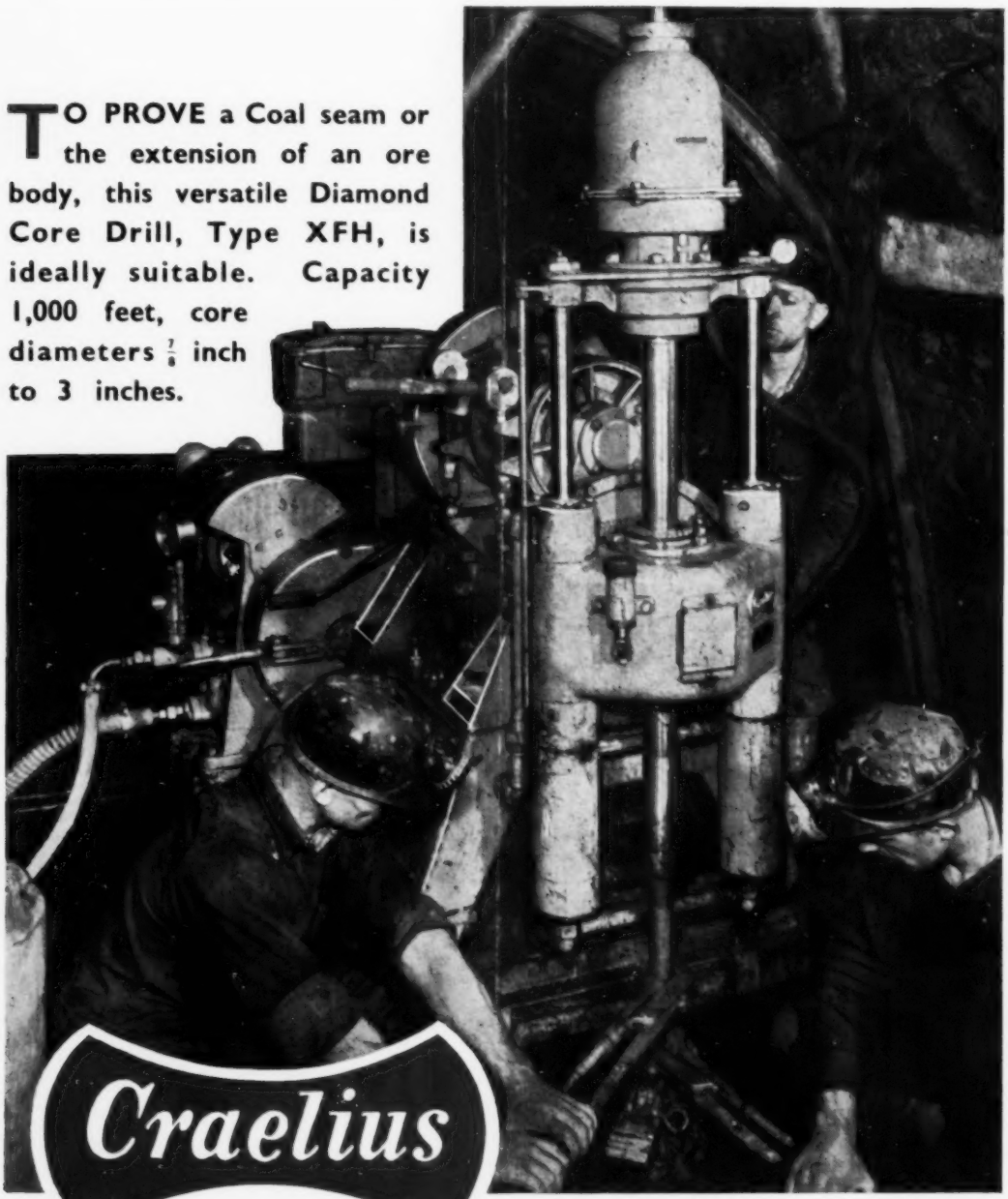

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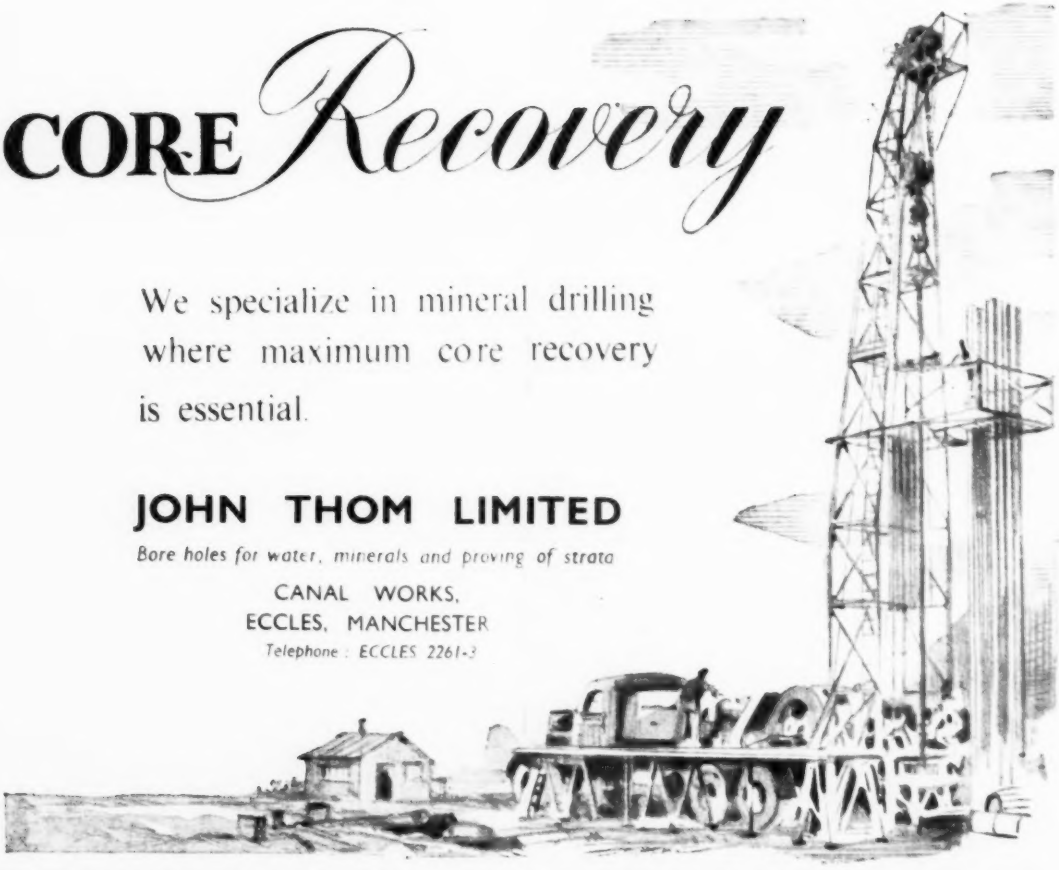

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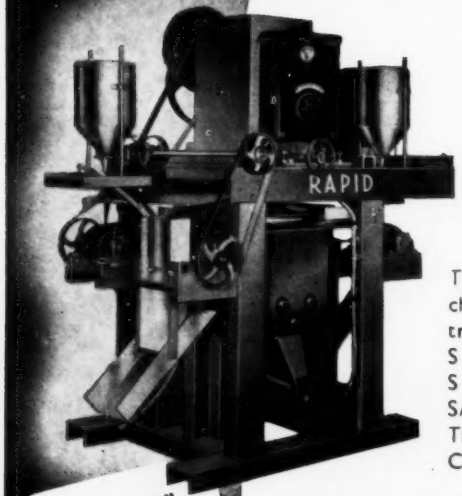

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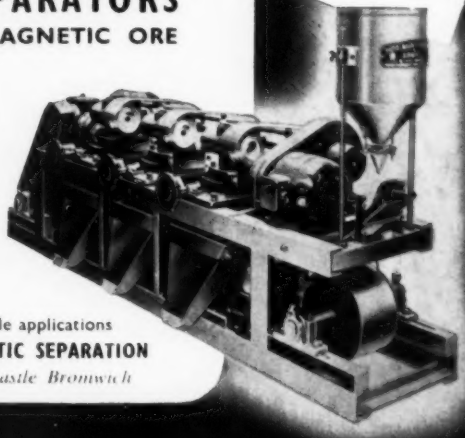

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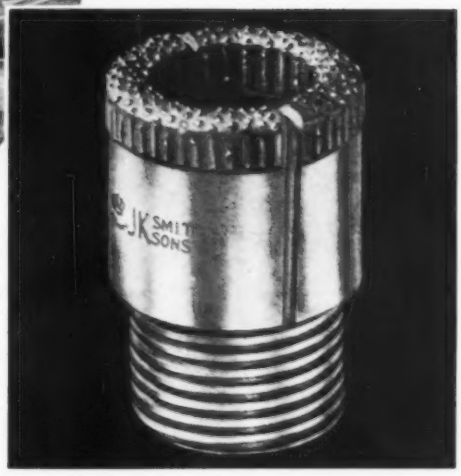

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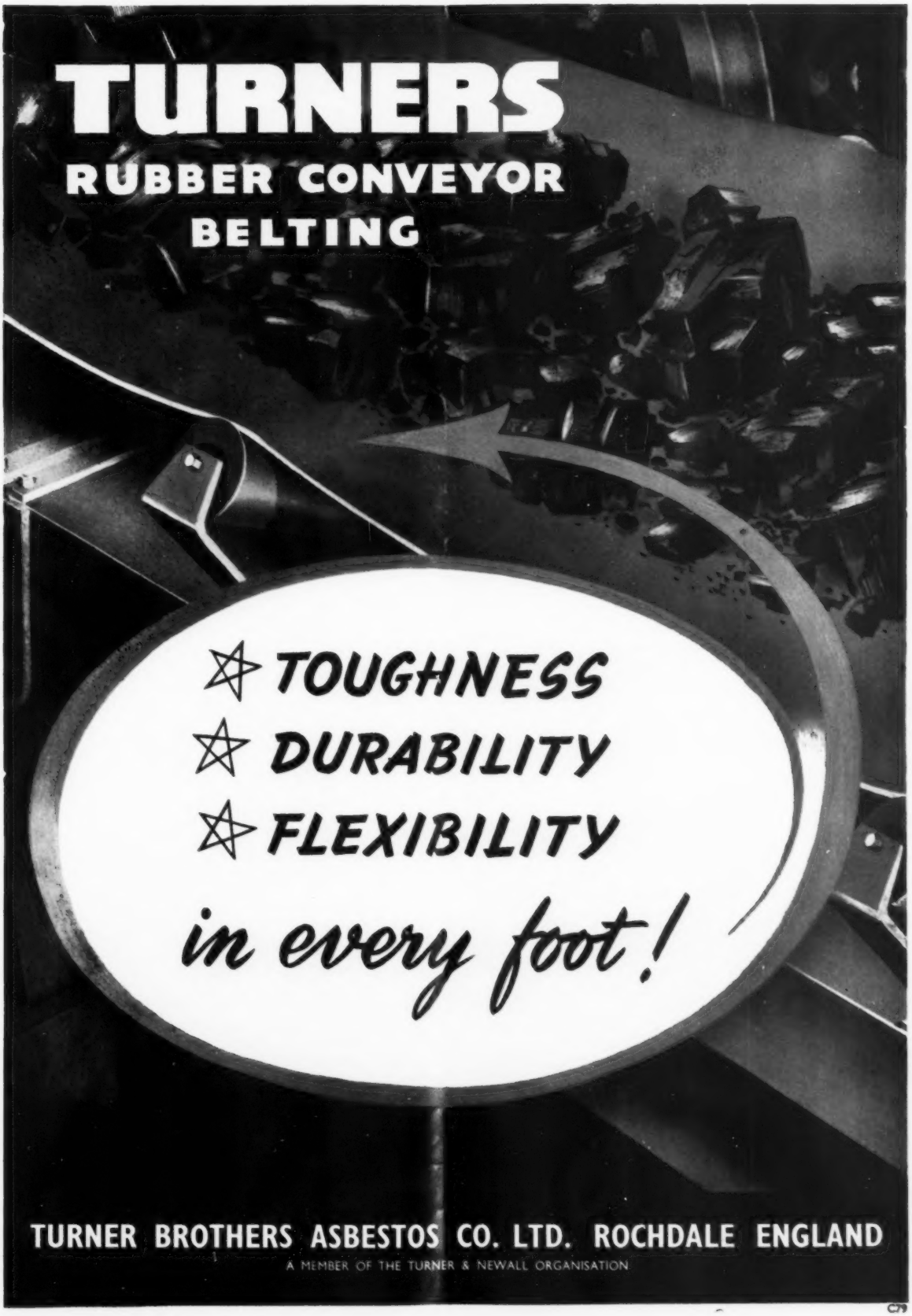
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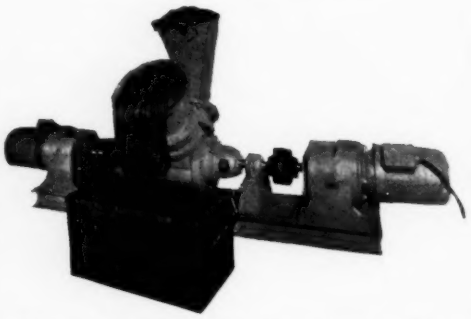

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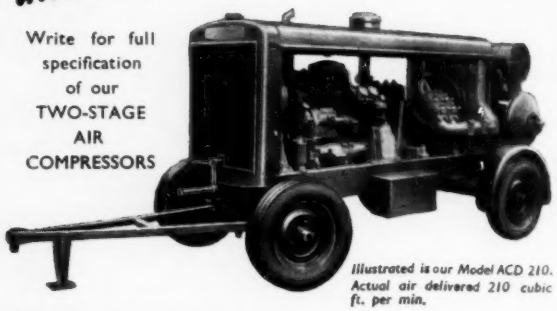

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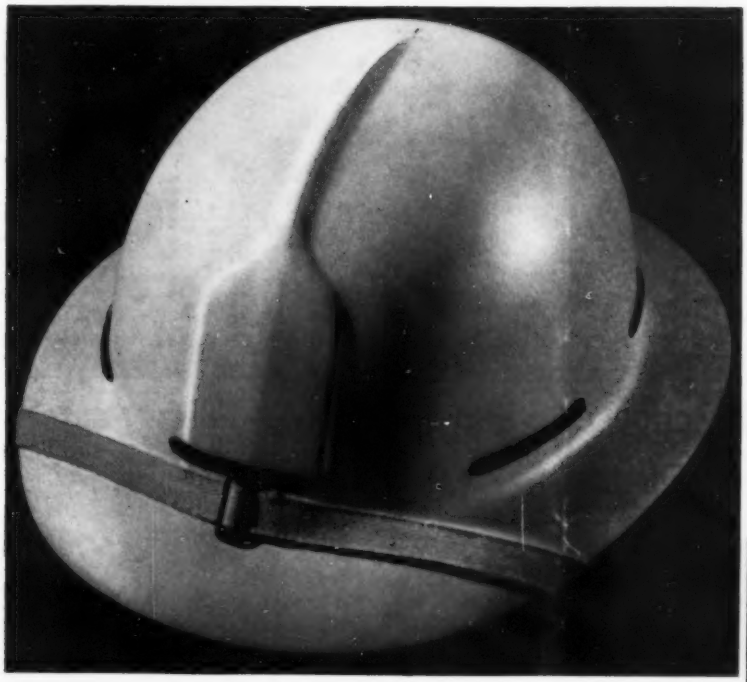

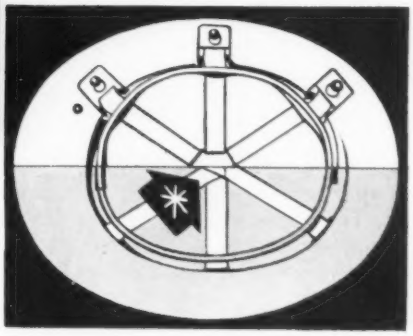

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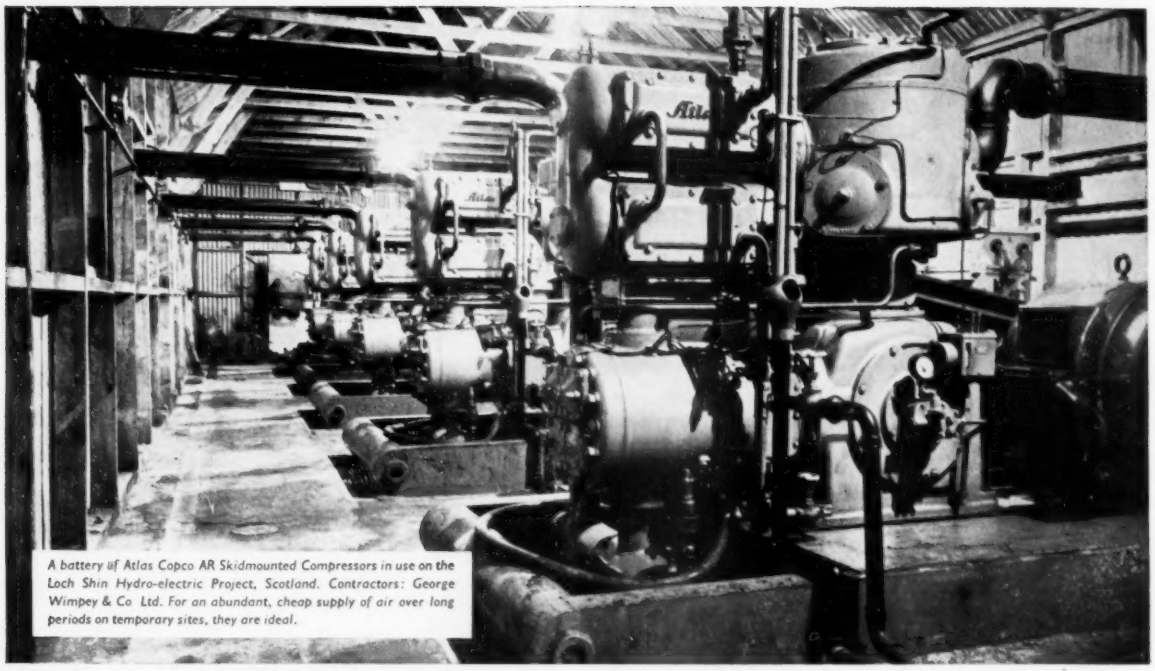

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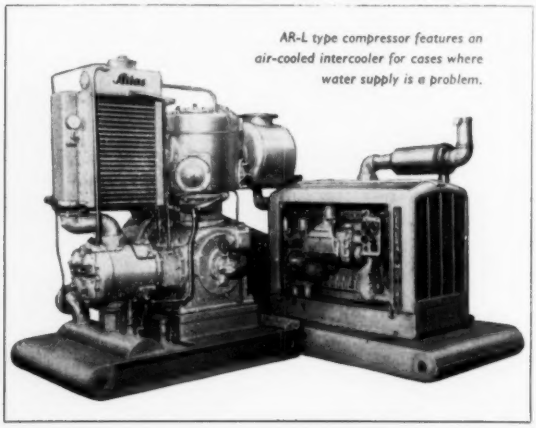

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NOTES AND COMMENTS

Britain's Contributions to Titanium Technology

The greater part of two decades has elapsed since Dr. William J. Kroll, a metallurgist who escaped from his native Luxembourg before the Nazi invasion, vainly sought support in the U.K. for his method of producing titanium metal. At that critical period the British Government was too greatly preoccupied with more urgent problems to give favourable consideration to a long term project whose practical value had yet to be established. Understandably, perhaps but none the less regrettably, Dr. Kroll was allowed to leave this country empty-handed. The very different reception awaiting him across the Atlantic is now metallurgical history. The Kroll process became the basis of a new industry of high strategic importance, in which the U.S., until quite recently, has enjoyed a virtual world monopoly. Apart from the time lag in starting commercial production, research and development in the United Kingdom were handicapped by difficulty in obtaining titanium in adequate quantities for research purposes, while the future of Britain's aircraft industry must have been gravely imperilled by America's commanding lead in the development of this valuable metal.

As in the field of atomic energy, Britain has succeeded in recovering much of the ground lost during titanium's early years and she is to-day in the forefront of technological progress.

Elsewhere in this issue we publish an article by Mr. Graham Oldham, in which recent developments in the extraction metallurgy of titanium are reviewed, among them being a number of processes which originated in British laboratories.

I.C.I. recently announced a reduction in the price of their raw titanium to about 21s. (below $3) per lb. Thus the company are producing titanium of the highest purity at the lowest price in the world by a process of their own development. Instead of the coke-like sponge of the conventional Kroll process, their product is in the form of small granules which can be pelleted with alloying materials ideally suitable for melting. It was announced in August that I.C.I. and Columbia-Southern Chemical Corporation had submitted a joint application for a contract whereby the U.S. Government would undertake for a five-year period to purchase 5,000 s.tons per annum of granular titanium metal produced by the I.C.I. sodium reduction process. The two companies believe that their proposal will result in lower capital and production costs and the acceleration of a titanium fabricating industry in the U.S.

In view of the difficulties experienced by the U.S. in making use of the metal commercially, it is particularly encouraging that titanium is to be employed extensively in the Bristol Proteus 755 turbo-prop engines which power the Bristol Britannia airliners. It will be used to replace stainless steel, being 42 per cent lighter with equivalent properties and having outstanding resistance to corrosion. The largest units to be fabricated in titanium will be jet pipe shrouds; other components to be manufactured in this metal include the inner cowling skin, the turbine shroud and the rear fire wall on the plenum chamber. The Bristol Aircraft Company estimate that the total weight saving will be about 560 lb. for each aircraft.

By proceeding systematically with the immense task of studying the constitution and properties of titanium alloys, the National Physical Laboratory is rendering to titanium the service it performed for aluminium many years ago, when the latter metal was at a similar stage of development, and the importance of this contribution to world research can scarcely be over-emphasized.

Outstanding contributions to titanium metallurgy are also being made by the Fulmer Research Institute, whose work has resulted in several recent patents relating to the production or purification of titanium metal. Soon after its formation in 1947, the Institute became interested in the extraction of metals by the decomposition of halides. Based on a novel method of approach, this work resulted in an entirely new process known as "catalytic distillation," which was applied in the first place to aluminium. This process is suitable for the extraction of aluminium alloys produced by thermal reduction in the arc furnace, or for purifying scrap or aluminium of commercial purity. Similar methods were subsequently applied to the extraction and purification of titanium and in some instances appear to be technically suitable for continuous operation.

The U.K. production of sponge titanium is still small by American standards, but the I.C.I. plant at Wilton has a capacity of 1,500 tons annually, which is equivalent to roughly a quarter of the total U.S. production in 1955. I.C.I. have announced their intention of building a £2,000,000 factory at Swansea for the fabrication of titanium, which should be in production by 1958. A titanium melting plant under construction at Birmingham by

William Jessop and Sons, a subsidiary of B.S.A., is reported to be nearly complete. The year 1955 has clearly been one of substantial progress both production-wise and in overcoming technical problems. Britain's new titanium industry is being developed on sound and imaginative lines and can look forward with confidence to the development of expanding markets at home and overseas.

No Glitter for Producers in Canada's Free Gold

Canada's return last week to a free gold market, commented upon briefly in our issue of March 23, appears to have been unexpected even by the Canadian gold mining industry itself. In fact, perhaps the most surprising feature of this far from unwelcome development is that it has not come about at the request of producers, who do not even appear to have been consulted.

The suspension of the regulations of the Gold Export Act means, of course, that gold producers are free to sell the metal to any buyer in the Dominion. Formerly they had the alternative of either selling to the Canadian Treasury at $35 an oz. or selling outside the country at any price they could get.

A few years ago, when producers could sell only to the Treasury, they asked for the right to dispose of their gold elsewhere, because at that time the price of gold in many countries, commanded a substantial premium, amounting in some places to $50 an oz. or more. In order that producers might benefit from the enhanced prices obtaining on the free gold market, the regulations were altered in 1951 to allow them to sell overseas as well as to the Treasury. Since the end of the Korean and Indo-Chinese wars hoarding has dwindled and to-day the price of gold has, in general, been stabilized throughout the world at about $35, the price paid by the Canadian and U.S. Treasuries.

Unfortunately, the need for first-aid to an industry which is artificially prevented from passing on its own rising working costs remains undiminished. Canada is the second largest producer in the free world and its contribution to the development and prosperity of the Dominion cannot be measured in terms of revenue alone. In evidence presented to the Royal Commission on Canada's Economic Prospects, the Canadian Metal Mining Association pointed out that the search for gold had been the spearhead opening up the north, while capital accumulated through gold mining activity had been fruitfully employed in developing other metals and industries. Moreover, experience had shown that a strong gold mining industry was the best hedge which a country could have against economic depression.

The C.M.M.A. sees little chance of a long-term solution for the problem except by an increase in the price of gold adequate to offset the increase in production costs. It points out that those companies that have succeeded in continuing operations have done so because they have carried mechanical and technical efficiency to an unprecedented level. "Further increases in efficiency or reduction in cost will be difficult to achieve," states the Association, "and offer only very limited improvement in total production costs."

Canadian producers interrogated by the *Wall Street Journal* do not believe that freeing the market will affect the price, or that there will be any inclination on the part of Canadians to buy and hoard gold. It would appear that the benefits of Canada's return to free gold trading are likely to be psychological rather than direct. The psychological gains should by no means be discounted, however, bearing in mind that there are several bills in Congress to remove restrictions on the holding of gold by U.S. private citizens.

Now that gold is gradually regaining its traditional position as a commodity which can be bought and sold freely in the world's bullion markets, the U.S. Treasury may well find it increasingly difficult to keep the price pegged at a level which has long ceased to have any relation to monetary values.

Metals for Space Travel

It has become almost a truism that to-day's comic strips are to-morrow's scientific projects. Twenty years ago the invasion of Crete by paratroopers would have seemed scarcely less fantastic than the interplanetary adventures which fire the imaginations of the generation now of comic-reading age.

The possibility that fiction might once again be overtaken by fact was brought appreciably nearer by the U.S. project to build an artificial earth satellite, however diminutive, as a first tentative step towards the conquest of space. Now comes the news that an American food firm has begun testing materials that may be used in to-morrow's space ships—a reminder that man's achievements in surmounting his own physical limitations still depend primarily on the ability of the metallurgist and the mining engineer to provide him with the metals he requires.

Aircraft engineers, having mastered the sound barrier, are now concerned with the heat barrier, which is a very much tougher problem. As man reaches further and further into space he will come up against a third big problem—how to keep his vehicles from disintegrating under particle bombardment.

Scientists working in the mechanical division of a large food factory in Minneapolis have built and placed in operation a "space chamber" where conditions liable to affect artificial earth satellites and space vehicles can be simulated. Inside this chamber samples of metals and other materials are bombarded with invisible electrically-charged particles moving at speeds of about 20,000 miles an hour. In order to permit close temperature control, the entire chamber is immersed in water.

A sample of metal, varying in size from the head of a match to a man's fist, is placed inside the main chamber, from which air is exhausted until the near-vacuum of the outer atmosphere has been reproduced. Electrically-charged atoms are then fired at the sample at a speed of 20,000 m.p.h. The number of atoms dislodged by the impact determines the "sputtering" or disintegration rate of the substance under test.

After testing nearly 30 metals in the chamber—including aluminium, iron, titanium and zirconium—it has been established that "even the best of current metals" will disintegrate after prolonged exposure to space conditions. According to Dr. Gottfried K. Wehner, who is conducting these experiments, the most important discovery in this laboratory to date is that the tendency to disintegrate is not caused by heat generated when fast-moving particles collide with a solid substance. It is the momentum of the charged particles and the angle at which they strike that determines how many atoms will be dislodged, with consequent disintegration.

The experiments are said to have shown that available alloys "are not adequate for the jobs ahead". It is concluded that, since there are few new metals to be discovered, the old ones must be given entirely new properties. The company responsible for this pioneer work on space metals believes that "this can, and will, be done within the next decade".

It may well happen that within a few decades the requirements of space travel—like those of nuclear energy and supersonic flight—will have a significant impact on the metal markets.

Iron and Steel

(From Our Own Correspondent)

From all the principal centres of steel production in both hemispheres there is a singular unanimity of testimony. Despite enlarged capacity and record outputs, there is an insistent civilian demand far in excess of capacity and plans are far advanced for further expansion.

Although U.S. ingot production is reported to have "settled down" to a weekly tonnage of over 2,400,000 scarcities persist and it is affirmed that during the next three months the position may become critical. Within that period a new wage agreement must be negotiated. The Steelworkers' Union is reported to be preparing one of the costliest wage programmes it has ever presented and since the industry has to keep the iron making and steel furnaces in operation at all costs, the Union is in a strong position to enforce demands which may include not only a substantial hourly pay increase, but also a guaranteed annual wage and premium rates for week-end work.

American experience is matched by that of Canada where the mills are now booking orders for the last quarter of the year and new production targets have been fixed, and with the exception of Rumania, each of the major European producers has increased production to record heights.

Imperative requirements for capital developments have fired the ambitions of other nations also. India's aim to attain an annual steel production of 18,000,000 tons in 1966 has been widely publicized, and as a further step in that direction an announcement has been issued from New Delhi that "a broad agreement" has been reached with a British consortium for the erection of a 1,000,000 ton plant at Durgapur in West Bengal at a cost of £50,000,000. A British bank syndicate is giving credits to the extent of £11,500,000, and a loan of £15,000,000 having been offered by the British Government it is expected that the contract will be signed in July. Aided by an American loan of £1,200,000 Chile is going ahead with the construction of a £3,000,000 hot strip mill, and Argentina has embarked upon very much bigger developments which include a steel plant with an annual capacity of 588,000 tons, and new hot plate, sheet, strip, and tin plate mills.

STRONG DEMAND IN U.K.

The position in the U.K. was aptly summarized by Sir Ernest Lever in his presidential address to the British Iron and Steel Federation when he said that consumer demand has outstripped even consumers' own forecasts. Already the target for this year has been raised to 21,300,000 tons and it is certain that this will not be enough to meet all requirements. "We are determined," said Sir Ernest Lever, "that our present dependence on imports will be reduced," but that can only be a gradual process.

By 1958 when the second development plan will have reached completion the total output of steel in this country will be almost double the output at the end of the war. But plans are already in course of preparation for further expansion and it is now confidently anticipated that a new £160,000,000 integrated iron and steel works may be built in South Wales by Richard Thomas and Baldwins. It is an immense and costly project, not to be undertaken without exhaustive investigation, but Mr. H. F. Spencer, the managing director of the company, has gone so far as to affirm that the erection of such a mill for the production of strip has become "an economic necessity".

All these developments at home and abroad have given a further tremendous impetus to the post-war scramble for iron ore, and other raw materials. U.S. steel is confronted with a steady shrinkage in the domestic reserves of high-grade ores, and although increased tonnages are now being supplied from Canadian and South American sources, the bigger U.S. steel corporations are also accelerating plans for extracting usable material from the still extensive deposits of low-grade ores, such as the "jasper" ores of Michigan, and taconite from Minnesota. The rapidly expanding steel industry in Japan is confronted with similar problems, and hopes to conclude very shortly an agreement for substantial ore imports from India. Capital assistance from the U.S. is believed to have been promised and to assist India's developing export trade rail transport facilities in Orissa are in process of extension.

THE ORE-CARRYING FLEET

Hitherto ore supplies have kept pace with the growing needs of British blast furnacemen. The industry has steadily enlarged its sources of supply, big capital sums have been invested in ore handling and preparation plant, and further steps have been taken to provide safeguards against the uncertainties of sea transport. To this end B.I.S.C. (Ore) which buys and transports from abroad on behalf of U.K. steel companies, has made arrangements with British shipowners under which it will be in possession of a fleet of 57 new ore carrying ships by the end of 1959.

All of these ships which are now on order or under construction will be chartered by B.I.S.C. from the owners for periods of 10-15 years. B.I.S.C. will not be the owners of these ore carriers but has a minority interest in some.

The organization calculates that by 1959 about 9,000,000 tons of imported ore will be carried by vessels under its own control. Meanwhile, about 50 other vessels have been engaged on time charter and a number of converted tankers have been brought into service.

Considerable tonnages of scrap are also being imported, but supplies are increasingly scarce, and so very costly that a new and intensive drive for more home scrap is contemplated and plans are under consideration for another effort to secure additional supplies from municipal authorities.

Cornwall

(From Our Own Correspondent)

Camborne, March 21.

It is understood that a firm of mining engineers are considering the working of an undersea deposit of sand containing cassiterite in the St. Ives Bay (involving carrying out sampling), and have asked the Cornwall Sea Fisheries Committee at Truro for a licence to proceed with their investigations. The committee is understood to have decided to ask the firm how they intend to work the deposit if the prospecting proved successful and to point out that a licence would only be granted if an assurance were given that the working of the tin was not likely in any way to jeopardize fishing in the bay.

St. Ives Bay has long been known to carry tin-bearing sand some of which is concentrated by the tide and has been worked above low water at Gwithian about 30 years ago by Beach Tin Ltd. and more recently by Mineral Recovery Ltd. Some years ago a scheme for working the undersea deposit was prepared but the project did not come to fruition.

At South Crofty Mine, the work of modernizing and increasing the capacity of the treatment plant is now under way. A new building to house the additional plant has been erected and foundations are being prepared whilst modifications to the existing plant are being made gradually so as not to interfere with production.

Minerals Prospecting in Northern Rhodesia

Prospecting for minerals in Northern Rhodesia has, over the past two or three years, become one of the Territory's major activities. With five big mining combines and several smaller concerns committed over the next four or five years to spending between them some £600,000 annually, the search for new mines is bringing almost as great an income to the Territory as the export of tobacco. The following article describes the prospecting activity currently taking place in Northern Rhodesia, and together with that describing similar operations in Southern Rhodesia published in our issue of March 16, 1956, provides a useful insight into the minerals potential of the Central African Federation.

The five big concerns whose prospecting teams are covering vast areas in the Central, North-western and Northern Provinces are Rhodesian Selection Trust, Anglo American, the British South Africa Company, Rio Tinto and de Beers.

The very large sums which these concerns are spending are being employed in applying the latest techniques, including the use of aircraft and magnetic prospecting devices which will enable them to narrow down the search to a few selected promising areas, each of which will then be subjected to intensive study.

These new devices not only enable prospectors to cover the ground much more quickly, but also make it much easier to penetrate any blanketing layer beneath which the true geological formation may be hidden (vast tracts of Northern Rhodesia are, for example, hidden beneath a layer of Kalahari sand).

A PERIOD OF OPPORTUNITY

What are the factors which have led to this immense activity at this time in the north? Principally they are because the mining companies nearly everywhere in the world have never, at any time, had such a wonderful opportunity as they have at present to secure their future by the location of new deposits, which will be available both to increase their present output and for exploitation after present reserves are worked out.

Sustained metal prices in world markets have left substantial margins not only for payment in dividends and higher wages but also to be ploughed back in development and exploration. At the same time, universally increasing taxation has played a large part in inducing managements (were inducement necessary) to invest in the future. New developments and discoveries in metallurgy and engineering have created a demand for new alloys, and provided new uses for those metals which are already being exploited.

PROMISE BEYOND THE COPPERBELT

It is too early to prophesy with accuracy what the results of the present prospecting activity will be. There are, however, several very promising developments outside the Copperbelt itself.

Thirty-five miles to the south-west of Lusaka, the Anglo American Corporation have, after several years of investigation, now taken a firm decision to exploit the King Edward copper mine. It is at present proposed that only the minimum of surface plant should be erected on the site, and that most of the refining should be done on the Copperbelt.

In the Fort Rosebery District across the Congo Pedicle, an American concern, the Rhodesia Vanadium Corporation, have bought from Weedon's Minerals a 200-sq. mile manganese prospect and have already spent considerable capital on development. Manganese is being mined by opencast methods—it occurs only close to the surface—and big development now awaits the completion of the rolling mill and the arrival of heavy earth-moving machinery to attack the overburden.

Fort Rosebery's manganese finds a steady market in the United States of America, where various steel manufacturers have found its quality exactly suited to their needs.

There are known to be other occurrences of manganese ore throughout the Luapula area, where Rhodesian Selection Trust prospecting teams have for some time been at work. The Luapula is already one of the main centres of African wealth in the Territory, being the headquarters of the fishing industry, and any considerable mineral development will enhance the prosperity of what is already a healthily thriving area.

Weedon's Minerals, having sold out their Fort Rosebery concession, have moved northwards into the Kawambwa District, where they are investigating a known copper occurrence at the north-eastern corner of Lake Mweru.

Various smaller concerns are occupied with both investigations and development in the Central Province (of which Broken Hill is the centre).

Gypsum Industries are developing manganese at Chiwefwe on the Great North Road and at Kamapumba on the Broken Hill-Mulungushi road; while Magundi Mines are pumping water out of all the workings at Matuga Copper Mine—an interesting prospect since copper occurs here in granite formations. It is, however, consequently extremely patchy.

TWO INTERESTING PROSPECTS

No account of new mineral development in Northern Rhodesia would be complete without reference to what are probably the two most promising discoveries outside the Copperbelt—the pyrochlore deposits at Nkumbwa in the Northern Province and the coalfield 35 miles from Choma in the southern.

There are considerable difficulties in the way of development of either, transport being the principal one, since Nkumbwa is in the Isoka District and 400 miles from a railhead in any direction: while the coalfield, though only 35 miles from the railway, lies at least 2,000 ft. below it down a steep escarpment.

Development of the pyrochlore (an atom-age mineral containing niobium) may be linked with that of the considerable mineral wealth in the Southern Province of Tanganyika, where progress during the past two or three years has been remarkable.

Whether or not our coalfield is ever exploited may well depend on the prospects of obtaining power for the Copperbelt from other sources before 1960. But it is now known that the coal is there in sufficient quantity, and of sufficiently high quality, to be worked if necessary.

It is not so good as Wankie coal, but it may well prove desirable to use it to make good the annual shortfall which the copper mines have almost come to regard as inevitable. It is, moreover, quite certain that the destruction of the forest land surrounding the Copperbelt cannot be allowed to continue for much longer.

Whether or not, however, these two known assets prove workable and paying propositions there is a marked spirit of optimism among the various prospecting teams all over the territory, and even the complete layman cannot help feeling that with all those men and all that money at work somebody must sooner or later find something pretty good.

The Extraction and Purification of Titanium

By GRAHAM OLDHAM, B.Sc., F.R.I.C., D.I.C., M.Inst.F.

During the past year and a half there has been much literature published concerning, and many patents claimed for, the extraction and purification of titanium. It is the purpose of this article to review some of this literature so that the information previously given to our readers may be brought up to date.

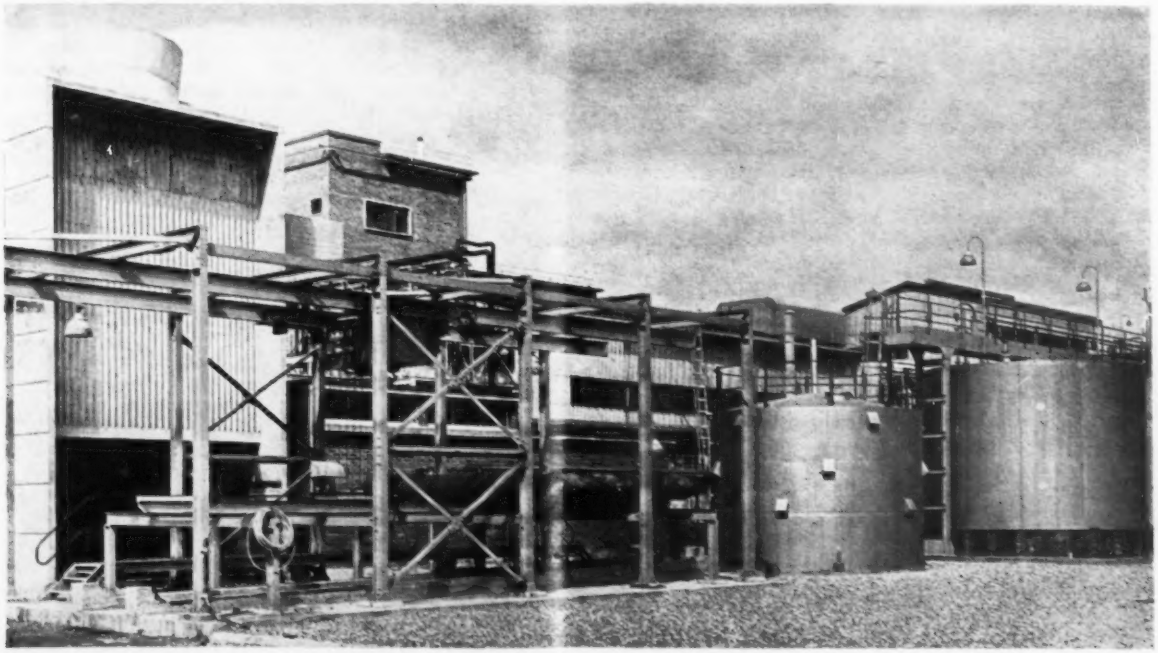
Most processes for the production of titanium chloride commence with the formation of the tetrachloride since this is volatile and reasonably easily purified. Judging by the American patent literature E.I. du Pont de Nemours and Co. are paying particular attention to the use of a fluidized bed technique. In one method claimed[1] the chloride is formed by fluidizing a bed of titanium ore and a solid reducing agent with chlorine gas at a temperature of 850-1,000 deg. C. The solid charge is heated with hot product gases and the amount of chlorine gas leaving the reaction is kept, by this process, to an absolute minimum.

In the second method claimed[2] chlorination in a fluidized bed is again used. A portion of the bed is continuously removed from the reactor, washed to free it from undesirable salts, and then returned. The method is said to be especially suitable for the treatment of titaniferous slags obtained from the smelting of titaniferous ores. In an example cited, the slag analysed TiO_2 72 per cent, FeO eight per cent, CaO 9 per cent, MgO 4.5 per cent together with inert material, silica and alumina 6.5 per cent. This was ground and fed into the chlorination furnace at a rate which maintained it in a fluidized state. Because of salt deposits, consisting mainly of calcium and magnesium chlorides, the particles soon become sticky and the furnace fails to operate. In order to prevent this occurrence, a part of the bed consisting of, approximately, 3 lb. per lb. of feed is continuously removed. It is washed, dried, reheated and returned to the furnace along with fresh feed material. The ferric and titanic chlorides in the product gases are separated by cooling.

A method for the production of the lower chlorides of titanium forms the subject matter of a British patent taken out by the Titan Company.[3] A mixture of strontium and sodium chlorides is heated in an electrolytic cell to 700 deg. C. and an impure titanium anode and a hollow nickel cathode inserted into the bath. Titanium tetrachloride vapour is passed in through the hollow cathode and a quantity of electricity of two faradays per mole of chloride added, is passed into the cell. The current densities of anode and cathode are 0.3 and 0.2 amp. per sq. cm. respectively and the applied voltage is approximately 1.3 V. The effect of this electrolysis is to produce soluble dichloride and trichloride from the tetrachloride and a portion of the anode material. After some nine hours the fused salt bath is used in the refining of impure metal.

MAGNESIUM REDUCTION PROCESSES

It is evident that magnesium reduction processes are still regarded with a favourable eye in many quarters in spite of the difficulties of batch processes and contamination of the product with magnesium, ferrotitanium, etc. An interesting paper by L. Gillemot[4] has dealt with the design and operation of reactors for this method of production. One reactor described is of 3.6 litres capacity and consists of a steel vessel with a conically fitting lid. It is contained in a resistance furnace which has a gas-tight water-cooled lid. Titanium tetrachloride is pumped into the magnesium-containing reactor by argon pressure maintained at about 100 mm. of mercury higher than the reactor pressure. The



General view of the I.C.I. General Chemicals Division titanium plant at Wilton, Yorkshire. The picture shows storage facilities for argon and titanium tetrachloride.

reactor products are ground and washed with two per cent hydrochloride acid. The titanium tetrachloride ratio fed during reduction is kept as high as possible in order to keep the magnesium content of the sponge low.

An ingenious variation claimed by E. M. Smith[6] uses the titanium tetrachloride as a propellent to spray liquid magnesium into a reaction chamber kept at between 1,400 deg. and 1,600 deg. F. The amounts of magnesium and titanium chlorides are maintained in correct stoichiometric amount and the reaction chamber is filled with inert gas. A ductile titanium is produced, suitable for commercial use.

W. C. Lilliendahl and E. D. Gregory of the Westinghouse Electric Corporation[7] have devised a method, equally suitable for the production of titanium or zirconium, in which a mixture of the oxide and calcium chloride in equal amounts are heated with a 100 per cent stoichiometric excess of magnesium at 1,000 deg. C. for 30 min. in an argon atmosphere. After leaching and washing, the partially reduced titanium is filtered and vacuum dried. It is then mixed with a 100 per cent stoichiometric excess of calcium, enough calcium chloride to render the mixture fluid, and re-reduced. After removal of the side reaction products, the metal may be hydraulically pressed and sintered at 1,450 deg. *in vacuo* or in an inert atmosphere.

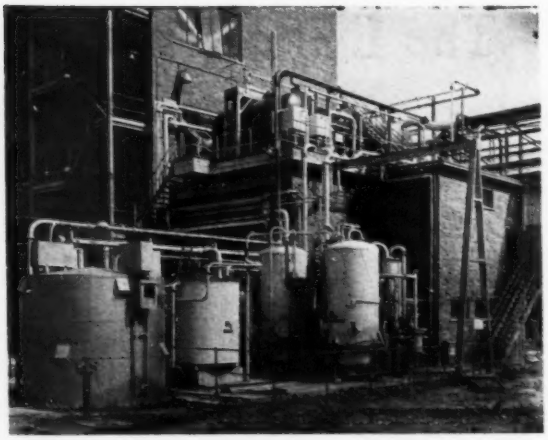
The Dow Chemical Company have claimed an apparatus which may be used for the production of either zirconium or titanium.[7] It consists of a gas tight apparatus having a rotary heat-controlled disc upon which magnesium particles, preferably passing a No. 20 sieve with a minimum retention of 95 per cent on a No. 200 sieve, are laid down in the form of a circular train. The heat-controlled surface has a pile forming zone where the magnesium particles may be continuously introduced. There is, further, a preheat zone, an igniting zone, a smouldering zone, a zone for draining off the magnesium halide and, finally, a titanium sponge-removal zone.

SODIUM REDUCTION PROCESSES

As readers of *The Mining Journal* will be well aware, sponge production by sodium reduction was started in this country by the I.C.I. on a pilot plant scale in 1954. The company has now built an extraction plant at Wilton, in Yorkshire, which can produce 1,500 tons of raw titanium a year. A second factory, the Kynoch Works of the Metals Division in Birmingham, has also been built and is concerned with the melting and forging of the metal produced at the Wilton factory. The great demand for fabricated products has resulted in a decision to build a new factory at Waunarlwydd (South Wales). A number of patents have been taken out on the sodium reduction process by this company describing several variations of the process. One patent[8] claims a process in which a closed reactor is half filled with powdered sodium chloride, the vacant space being filled with argon. Molten sodium and titanium chloride in stoichiometric amounts are allowed to react, the mixture being vigorously stirred. The sodium content of the reactor is held at about one per cent of the mixture and portions of the bed, which remains in a powdery state, are removed from time to time without interruption to the process. The mixture is cooled and leached with water to yield titanium of 99.5 per cent purity.

As a variation of this process, sodium amalgam, containing between 0.05 per cent and four per cent by weight of sodium may be used in place of pure sodium.[9] A temperature of 250-300 deg. C. is necessary in order that the reaction shall go to completion.

The reaction of sodium and titanium tetrachloride yields a fine powder. The freshly produced powder may be converted to a sponge suitable for the production of ductile metal by maintaining it at a temperature of at least 800 deg. C. for not less than 15 min.[10] The temperature should not be allowed to rise above 1,000 deg. C. otherwise contamination of the titanium by the iron vessel will occur.



The titanium plant at Wilton

OTHER REDUCTION PROCESSES

Other methods of reduction have been reported from time to time. The Fulmer Research Institute Ltd. have claimed a process[11] in which impure titanium is first produced by the carbon reduction of titanium ores. A gaseous mixture of argon, zinc, and zinc bromide is then passed over the impure metal at a temperature of approximately 1,000 deg. C. The titanium forms the dibromide which is then passed over molten zinc when a zinc-titanium alloy, containing approximately two per cent titanium, is formed. The alloys produced is then heated *in vacuo* at about 1,000 deg. C. when the zinc distils to leave a titanium metal which contains very little carbon.

Workers at Fulmer have found that the normally stable lower chlorides or bromides of titanium, especially the dihalides, can be obtained very conveniently and with a high yield by reaction of the corresponding halide vapour with a heated titanium-bearing metal, preferably under reduced pressure. In one patented method, the unsaturated vapour of a titanium halide of the chloride or bromide group is passed over a titanium-bearing material at a high temperature and in an inert atmosphere, thereby forming the vapour of the corresponding lower normally stable titanium halides. The vapour is led into a cooled zone in which the lower halides partly decompose directly into metallic titanium and tetrahalide and partly condense. By suitable treatment of the condensate the whole of the tetrahalide originally used may be reapplied for further extraction and by using two or more converters, continuous extraction can be achieved. In a modification of this method the gas vapour is brought into contact under suitable conditions with an absorbent such as lead or cadmium. A second modification consists in passing the tetrahalide over a mixture of carbon and titanium-bearing material, forming a gaseous mixture containing lower titanium halides and carbon monoxide, which is then shock-cooled.

J. Glasser of the Kennecott Copper Corporation has developed a process[12] in which titanium tetrachloride, at a partial pressure of 0.5 mm. is reduced with hydrogen in a molten sodium chloride bath at 900 deg. C. When the composition of the bath reaches 20 per cent titanium dichloride and 80 per cent sodium chloride by weight, a refractory surface, at a temperature at least 100 deg. C. higher, is lowered into the bath. This causes decomposition of the dichloride to metallic titanium which is recovered in the form of particles of approximately 200 dia. The metal

obtained is ductile and stable in air.

An alkali or alkaline earth amalgam reduction of the tetrachloride has been claimed by F. Köhler.[13] The resulting mixture of titanium amalgam and metal chloride is separated from excess mercury and distilled, either *in vacuo* or in an inert gas. The titanium is then extracted from the distillation residue. It is suggested that the process is best carried out as an indirect electrolysis in closed cycle. For example, a potassium chloride solution is electrolyzed in a conventional alkali cell having a mercury cathode. The potassium amalgam is passed through a tube having an amalgamated surface. The amalgam must be insoluble in mercury and this arrangement is said to prevent the entrainment of aqueous solution. Nickel is a suitable metal for the tube which leads into the reaction vessel where the titanium is produced.

ELECTROLYTIC METHODS

Molten electrolytic methods of production are attended with extreme difficulties and are not, at the moment, regarded with very great favour. The bath must be quite stable and must, in addition, contain enough oxygen to prevent secondary anode reactions. Further, there must be separate anode and cathode compartments with continuous removal of the cathode deposit in the absence of air—a problem which appears to be very difficult to solve.

The Horizons Titanium Corporation is one company which appears to be specially interested in electrolytic production and in 1954 constructed a pilot plant for the production of titanium powder by the electrolysis of potassium fluotitanate in molten sodium chloride. Such a method was the subject of a recent patent[14] of this company. Sodium or potassium fluotitanate is obtained in a pure state by recrystallization. The crystals are filtered, washed, and vacuum dried. Alternatively the fluotitanate may be formed *in situ* by the interaction of the alkali fluoride and titanium tetrafluoride vapour. A molten mixture of the fluotitanate and the corresponding alkali metal chloride is electrolyzed at about 700 deg. C., powdered or granular titanium oxide being added intermittently. Electrolysis is carried out in a graphite container with a graphite anode and iron cathode and the anode and cathode compartments are separated by a graphite partition. Operation is carried out on an inert gas and an airlock prevents air entry during removal of the titanium coated cathode. The cell operates with a voltage of 4.2 to 7 V. and the current efficiency varies between 70 and 90 per cent. The titanium granules obtained are mostly larger than 200 mesh and some are up to 0.2 in. long.

The I.C.I. have also taken out a patent[15] on an electrolytic process in which the titanium is produced by electrolyzing pure titania in a molten calcium chloride bath at 800 deg. C. The cathode is molten zinc and when its titanium content reaches 2.5 per cent the alloy is removed and the zinc distilled off under reduced pressure to leave titanium metal containing less than 0.01 per cent zinc.

Plant at Wilton for making pure nitrogen

METAL PURIFICATION

Purification of the metal is an important feature in most processes. T. D. McKinley of E.I. du Pont de Nemours and Co. has devised a process for the purification of titanium metal obtained by magnesium reduction of the tetrachloride.[16] Magnesium is the chief impurity and may be removed by leaching at between 40 and 50 deg. C. with an aqueous solution containing between two per cent and 15 per cent sulphuric acid and 0.05-1 per cent organic amine inhibitor. The inhibitor suggested for this purpose is a rosin-amine-ethylene oxide reaction product.

The National Lead Company[17] suggest that contaminants may be removed by leaching with an aqueous solution containing mineral acid (2-10 per cent), a ferric salt (0.5-6 per cent) and a nitrate (2-10 per cent). In an example quoted, 70 parts of titanium were leached with 1,500 parts of a solution containing 45 parts of hydrochloric acid and 150 parts of ferric chloride for four hours at between 25 deg. and 45 deg. C. After washing and drying for three hours at 150 deg. C., the metal contained substantially no magnesium or magnesium chloride.

The Fulmer Research Institute Ltd., have taken out two patents covering the purification of titanium. In the first,[18] a stream of argon saturated with titanium tetrachloride vapour at 20 deg. C. is passed over the impure metal which is at about 1,150 deg. C. The gaseous products are mixed with hydrogen and heated to 1,300 deg. in an adjoining reaction chamber where pure titanium is deposited. The gaseous products are then recycled. In the second,[19] sodium chloride vapour is passed over impure titanium *in vacuo* at 1,150 deg.-1,400 deg. C. The gas on cooling yields pure titanium and sodium chloride which can then be recycled.

The field of extraction metallurgy is a highly competitive one. Particularly is this so in the case of titanium extraction and much of the information must, inevitably, be gleaned from the patent literature. Because a company patents a particular process it does not, naturally, mean that the process is necessarily being employed. Nevertheless a patent review certainly does indicate general trends and this review does not pretend to do more than this.

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(3) B.P. 716, 853.
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(6) U.S.P. 2,707, 679.
(7) B.P. 734, 166.
(8) B.P. 717, 930.
(9) B.P. 720, 543.
(10) B.P. 720, 517.
(11) B.P. 719, 551.
(12) U.S.P. 2,706, 153.
(13) Austrian Pat. 181, 430.
(14) U.S.P. 2,707, 170.
(15) B.P. 724, 198.
(16) U.S.P. 2,707, 149.
(17) B.P. 726, 367.
(18) B.P. 723, 879.
(19) B.P. 723, 880.

KOEPE SYSTEM IN SOUTH AFRICAN GOLD MINES—II.

Effect of Rope Strength on Koepe Installations in South African Gold Mines

The following article is the second of a series which discusses the efficiency of the Koepe hoisting system in gold mines of the Witwatersrand and Orange Free State. Points discussed in this instalment are the limiting effect of rope strength on Koepe installations while in addition the impracticability of period destructive tests is discussed and rope safety factors for various duties are examined. The article is condensed from a paper presented at the monthly general meeting of the South African Institution of Mechanical Engineers on January 12, 1956, by L. T. Campbell Pitt, O.B.E., M.I.Mech.E., a Past President of the Institution, and F. G. Zeppenfeld and A. W. P. Hallett, M.A.(Cantab.), M.I.Mech.E., members. Subsequent instalments will conclude the authors' remarks on rope safety factors and will consider the capacity of Koepe and drum winders respectively.

The ropes are a main factor in every rope hoisting problem and the greater the depth the more important this becomes until—for deep vertical shafts—they determine not only the shaft capacity but the hoisting system.

The factors of safety and provision for rope deterioration for drum winders have been determined and are given clearly in the Regulations of the Mines and Works Act. As experience has been gained, so those Regulations have been amended. In the Koepe system the rope itself is the same in composition and structure as it is for the drum winder system.

CONSIDERATIONS OF SAFETY

The authors feel that non-destructive tests will in time supersede in importance the periodic destructive test because it is much better that the whole rope be tested and not a small piece of the end which many, but not by any means all engineers, regard as the weakest point. If the periodic destructive test of a specimen is an advantage, then the rope factors of safety for the Koepe system must be increased above those of the drum winder ropes. It is felt that this is a cautious point of view which will change as use of non-destructive testing proves its effectiveness.

Consideration has been given to making provision in a counterweight for accommodating on a magazine reel sufficient rope to allow for the periodic cutting of a test specimen at the conveyance attachment. An objection to this is that the reel would have to be smaller in diameter than we would like and so a rope would be paid out from it which has been bent under load round a diameter smaller than desirable. Further, there would be complications in the design of such rope storage arrangements for multi-rope hoists.

In the Koepe system the load on all points of the rope varies by only the pay load, which is a small proportion of the total load and one that decreases with greater hoisting depth. This, then, would justify a decrease in the safety factor for Koepe ropes.

Compared with the drum winder, which requires the rope to bend over sheaves, coil usually in layers on a drum and fleet across coil by coil from drum flange to drum flange, the Koepe hoist rope bends over one drum and usually over one deflecting sheave. It neither fleets nor coils. It rests in a groove of material softer and more accommodating than the steel on which the rope of the drum winder rests. Moreover, the determining factor for drum diameter of the Koepe wheel is pressure between the rope and driving surface which results in a bigger diameter than the rope/drum ratio of, say, 1/100 or wire/drum ratio of 1/1200 considered good practice in winding. It would be logical to reduce the factors of safety for Koepe ropes for this reason.

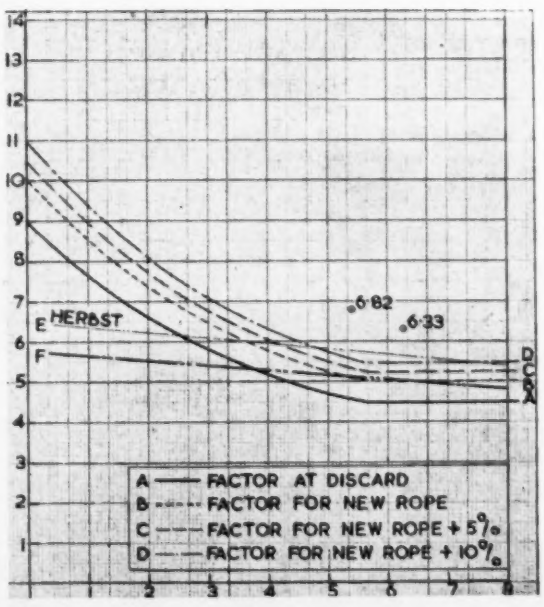
With regard to the multi-rope Koepe it may be considered that since there is more than one rope the aggregate factor of safety could be reduced. This is not the best assumption, however, and the ideal would be equal sharing of the load by all or both the ropes. That may not be possible in practice, however well equalization is provided for. It seems that the aggregate factor of safety for Koepe multi-rope systems should be increased for this reason.

In the Koepe system heavy grease rope dressing cannot be used. Will the lacquer or other dry types of dressing prove as satisfactory as a corrosion preventative? The authors think so. Overseas experience does not decry that opinion. In any case, for all ropes special wire coating such as cold galvanizing is a better protection against severe corrosion. No factor of safety provision should therefore be made on this account.

Consideration should be given where applicable to the effect of shock loads on ropes such as would be caused by loading from keps or landing baulks. As this condition does not arise in the New Consolidated Gold Fields Group and but rarely in these gold fields, no specific suggestions are made in this paper for corresponding modifications to the factor of safety.

THE HERBST FORMULAE

The formulae proposed by Dr. H. Herbst, formerly Head of the Bochum Rope-Testing Station of the West-



Factors of rope safety. Vertical numerals denote rope safety factor; horizontal numerals denote suspended rope 1,000 ft.

phalian Mines has been studied. Dr. Herbst proposed :

For Persons	9.5 — 0.001 T
„ Rock	7.2 — 0.0005 T

where T is the hoisting depth in metres. In Dr. Herbst's formulae which apply to new ropes, the factor of safety is calculated on the aggregate of the breaking load of the wires in the rope. To conform with South African practice, in which the factor of safety is calculated on the tested breaking load of the rope, a factor of .9 has been applied to the original formulae. A subsequent factor of .9 is applied to give the factors of safety at discard. The graph shows the factors of safety of these formulae and those of the present Regulations of the Mines and Works Act of the Union. In Dr Herbst's formulae which is for new ropes, a depreciation of 10 per cent has been allowed to give a discard graph.

We feel that we should not lightly, if at all, disregard the South African Regulation factors which have proved so satisfactory for our conditions. It is considered that with improved and more reliable non-destructive examination the single rope Koepe conditions are at least comparable to the drum winder rope. In the case of multi Koepe ropes, some allowance might be made in the overall or aggregate factor of safety to allow for unequal sharing of load by individual ropes and so we have increased the aggregate for a two rope Koepe by five per cent and a four rope by 10 per cent ; the graph shows these values. It will be appreciated that whilst the Regulation factors of safety are based on the capacity factor or the factor of safety of the rope at the attachment, for winding systems having a balance rope or ropes equal to the main rope or ropes in weight per unit length, the capacity factor always equals the factor of safety. The mathematician will question adoption of a formula based on a non-existent factor. The reply is that no acceptable formula based on first principles has been derived to allow for resilience of ropes as length increases. The capacity formula, empirical though it is, serves drum winder ropes and should serve Koepe ropes.

On the graph are also shown factors of safety granted for proposed Koepe hoists in South Africa. They are higher than is proposed as the ultimate.

In friction hoist systems the balance rope is a necessary component since without it friction provided would be insufficient for the main rope out of balance load. As a rope component its factor of safety should follow a comparable formula, i.e., one based on a "capacity factor" and decreased as rope length and, therefore, its resilience decreases shock and suddenly applied loads. Fortunately, in this respect the possibility of suddenly applied loads is remote. In any case, the rope is determined by the weight desired and not strength. In fact, lower tensile wires can be used in a balance rope than for a main rope and adequate factors of safety obtained. It is considered that the balance rope margins of safety should not be less than those of the main rope. Balance rope life is likely to be long, especially if it is allowed to loop naturally at its lowest point and is not passed over a tail sheave. The balance rope should receive the same inspection and maintenance as the main ropes.

INTERPRETATION OF REGULATIONS

Dealing with the application of the Union Regulations to rock hoisting only, three conditions have to be fulfilled simultaneously. These are :

(a) The maximum load attached to the rope must not exceed one-ninth of the breaking load of the rope ;

(b) The maximum combined weight of the attached load and that of the suspended rope must not exceed two-ninths of the breaking load of the rope ;

(c) The breaking load of the rope must not at any time be less than nine-tenths of its breaking load (new).

Conditions (a) and (b) must still apply to a rope whose breaking load has depreciated by 10 per cent and must therefore be discarded under Condition (c). Consequently, the load applied to a new rope must be adjusted so that it will comply with Conditions (a) and (b) for a rope about to be discarded.

If B = breaking load of new rope.
W = weight per foot.
L = suspended length of rope.

Then .9B = breaking load of rope at discard.

To comply with Conditions (a) and (c).

Maximum load which can be attached to rope under (a) .. .. .. $= 1/9 \times .9B = 0.1B.$

To comply with Conditions (a), (b) and (c).

At depth L ft. below sheave

Weight of suspended rope ..	$= WL$
Weight of attached load ..	$= .1B$
Total load on rope at sheave	$= .1B + WL$
Safety Factor $\times 0.1B + WL$ ..	$= 0.9B$
$4.5 (.1B + WL)$	$= 0.9B$
∴ Limiting condition ..	$L = \frac{0.1B}{W}$

From this it is seen that the attached or end load of 0.1B may only be applied to a rope at and above a critical depth in the shaft given by $L = \frac{0.1B}{W}$. At this depth, the attached load is equal to the weight of rope suspended from the sheave.

CONSIDERATION OF CRITICAL DEPTH

The initial factor of safety obtained by attaching this load to a new rope is given by :

$$\text{Factor of Safety} = \frac{B}{.1B + WL} = \frac{B}{.2B} = 5$$

This is the minimum which can be attained under the regulation, and as will be shown later, for depths below the critical depth the attached load must be reduced as the weight of suspended rope increases in order to maintain this factor.

The relation between B and W remains sensibly constant for a particular rope construction or number of wires per strand, and for the same class of steel. It varies slightly, however, with different constructions.

The breaking load of a rope of given diameter on the other hand varies very considerably with the class of steel from which the wires are drawn, while the weight per foot remains constant. Consequently, the ratio $\frac{.1B}{W}$ giving the critical depth will have a different value for each class of steel used.

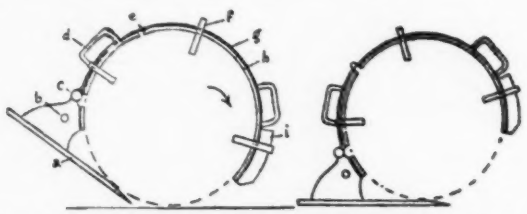
Class of Steel (tons p.s.i.)		*Critical Depth (ft.)*
90/100	..	4,075
100/112	..	4,500
112/123	..	4,950
123/134	..	5,400
128/140	..	5,600

For ropes having six strands of 32 wires per strand the critical depths are shown above.

MACHINERY AND EQUIPMENT

Protective Device for Mine Cars

To prevent mine cars running away backwards downhill in the event of the failure of a coupling or of intentional unhooking, an automatic device has been designed which can be inserted between one wheel and the body of a car. The device has been described in *Bulletin d'Informations Techniques des Charbonnages de France.*



At left, normal running position. A, brake shoe; B, rivet adjusted replaceable plate; C, hinge-joint; D, manipulating handle; E, hinge-joint; F, guide lugs; G, steel band; H, friction liner; I, counterweight. At right, the block-up position.

The device, it is stated, will hold fast a total weight of 100 tons, or about 13 cars each weighing 8 tons on a 16 mm. per 1 m. slope. It weighs 28 lb. and can be adjusted or removed instantaneously. The device controls the brake shoe which it will keep in an off position as long as normal running is maintained, but as soon as the car begins to run backwards the shoe is forced between the wheel and the rail, thus promoting a complete stoppage after a claimed backward movement of 25 cm.

New Range of Tropicalized Avometers

Until quite recently it was not possible to manufacture tropicalized Avometers at anything but a prohibitive price, and the manufacturers of this new range, The Automatic Coil Winder and Electrical Equipment Co. Ltd., believe that the United Kingdom is the first country to produce such an instrument.

When Avometers are used in locations where atmospheric conditions are constantly bad from the point of view of relative humidity or tropical cycling of temperature, it is desirable that certain components be given special protection. Thus the models 7, 40 and 8 (S) Avometers can now be supplied for use under these adverse climatic conditions. In the new range, certain components within the instruments are encased in an epoxy casting resin. This renders them impervious to the ingress of moisture. All the enclosed items are claimed to be fungus resisting or, where appropriate, metal parts have been plated. All instruments are normally calibrated at an ambient temperature of 90 deg. F.

Sierra Leone S.T. Begins Air Communications

Recent news of the use of aircraft in the mining industry is that Hunting-Clan Air Transport Ltd. were recently called in to advise on an interesting project. The Sierra Leone Selection Trust planned to buy a good bush-flying aircraft and use it mainly for communications between Freetown and their Yengema mine, some 150 miles to the east of the Capital.

HCA therefore sent out an operations consultant to Yengema. Subsequently a 700 yd. air-strip, with provision for a 300 yd. extension, was built, together with a hanger, and V.H.F. (very high frequency) radio was installed. Meanwhile a De Havilland Beaver Series 1 aircraft, with a special carburettor dust-filter, was bought from Canada and shipped across to England where a Hunting-Clan pilot and ground engineer, with previous bush operation experience, took charge of it. This crew have now transferred to the permanent staff of the Trust, and will operate and maintain the aircraft on a full-time basis.

The Beaver was then flown to Hunting Aerosurveys Ltd.'s base at Elstree. Here technicians installed a Williamson F24 vertical precision camera on a special mounting in the fuselage floor, together with a drift sight.

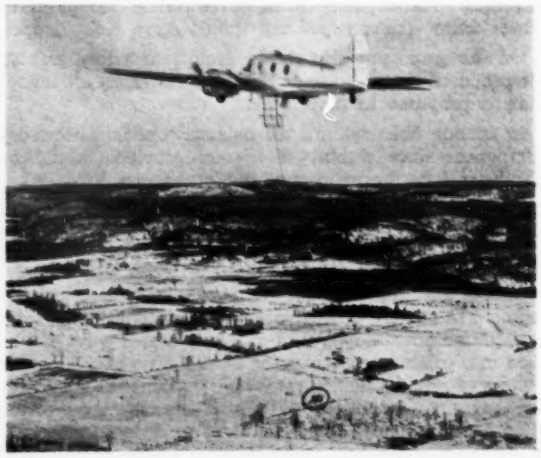
An Airborne Electromagnetic Detector

The formation of a company to work with a new airborne exploration tool was announced recently by three veteran companies in air surveys and geophysics. The new organization is Aerophysics of Canada, Ltd., established by Spartan Air Services Ltd., and Canadian Aero Service Ltd., both of Ottawa, and McPhar Geophysics Ltd., Toronto. Aerophysics will undertake contract exploration for base metals with a new high sensitivity airborne electromagnetic detector. The instrument was developed for Aerophysics under patents held by Dr. Stanley Davidson, whose pioneer work in electromagnetics is well known in mining exploration. The airborne electromagnetic device is flown at over 100 m.p.h.

During recent years, exploration for base metals in Canada has been advanced greatly through the use of electromagnetic methods. McPhar, which has specialized in the development and use of electromagnetic survey methods and equipment, includes among its major successes with this equipment, the large New Brunswick base metal discoveries. The latest McPhar development in airborne instrumentation is the system used by Aerophysics.

The funtion of the airborne EM survey is to localize rapidly the search for heavy sulphide bodies (principally copper and lead) in areas where such deposits are considered most likely.

The electromagnetic system uses a coil of wire to transmit an alternating field. When a conductive body, such as massive sulphides of lead or copper, comes within range it produces a secondary field. This secondary field is picked up by a receiving coil and the resultant signal is amplified and seen as a peak or anomaly on the EM record.



The receiver unit (ringed) in flight at end of 500 ft. cable, halfway between the aircraft and the ground

In the Aerophysics airborne system, the transmitter is carried in an Anson aircraft. The receiving unit is towed in a bomb at the end of a 500 ft. cable. The aircraft flies approximately 500 ft. above ground and the bomb trails about halfway between the aircraft and the ground. Complete records are taken of the output of the EM equipment, the aircraft altitude, and simultaneously aerial photographs are taken of the ground.

The Aerophysics system has shown high sensitivity to sulphide ore and good discrimination against overburden. Under favourable conditions ore bodies can be detected to depths of 300 ft.

MINING MISCELLANY

Mogul Mines is to supply Irish Copper Mines with $7,000,000 via a debenture purchase to enable the latter to put into production, at a rate of 3,000 tons of ore daily, its St. Patrick's copper mine at Avoca. With the debenture goes the right to subscribe to 1,725,000 shares of the Irish company at $3 per share.

* * *

Firms with activities considered useful to the economy of French Morocco will receive tax relief for their investments in equipment and capital goods, the territory's Finance Minister, Abdel Kader Bedjelloun, has told the Investment Committee.

* * *

An "important" mercury deposit is said to have been discovered near Siles in the Calderon mountains in the Spanish province of Jaen. According to reports from Spain, the exact extent of the deposit is not yet known.

* * *

The Hunting Group has formed a new company, Hunting Technical Services, its objects being to advise Governments, consulting engineers and commercial companies on all aspects of making better use of natural resources.

* * *

Considerable optimism is being expressed about the deposits of aluminium phosphate at Lam-Lam, near Thies in Senegal. Besides being exported in ore form this material is also being treated by dehydration. In 1955 exports reached 100,000 tons. The mining of phosphates in French Togo is still in an experimental stage, but appears to be promising.

* * *

Brazil's Economic Development Plan 1956/60 includes the following targets of production, among many others: steel 2,000,000 tons, aluminium 50,000 tons, cement 5,000,000 tons, the export of 10,000,000 tons of iron ore per annum by 1960, and the establishment of numerous factories. No information has yet been given as to how this plan is to be financed.

* * *

The Fort Victoria district produced nearly all the lithium ore mined in Southern Rhodesia in 1955. Of the total output of 82,000 tons, only 2,000 tons came from other parts of the country. Production by Bikita Minerals is to be raised by 10,000 tons annually to about 90,000 tons. The company has started a development programme estimated to cost over £1,000,000.

* * *

Dr. D. M. Fraser, Mining Division chief geologist, and Mr. P. Telfair, geological engineer, represented the Bethlehem Steel Company on a mission which investigated various aspects of the Mekambo iron ore deposit in Gaboon, French Equatorial Africa. They were accompanied by two engineers of the French Overseas Mining Administration. Bethlehem Steel is reported to have the permission of the French Government to carry out exploration in this region.

* * *

The "Kalewa Coal Special"—first train to bring coal from the Kalewa field to Rangoon—was welcomed by Burma's Minister for Mines. It carried the first "official" consignment of 30 tons of coal dust for the use of the Rangoon Electricity Supply Board. The Minister said that, while the present yield was only 50 tons a day, it was expected that by 1957, after the installation of modern machinery by a British firm, output would be raised to 1,000 tons a day, at which point Burma would be self-sufficient in coal.

* * *

The suggestion that the U.K. should make available to the Government of Equador a team of first-class geologists to explore the country is made in a report by Mr. Andrew Henderson, who visited various South American countries in May-July last year. So far few minerals have been found in Ecuador, but it is suggested that, in view of the mineral wealth of Peru with similar terrain, minerals do, in fact, exist, but have never been sought seriously. No suggestion as to the basis of payment for discoveries of minerals is made in the report, which is published by the Dollar Exports Council.

* * *

The general picture of developments in Ontario's mining industry during 1955 is given non-technically in a general review published by the Ontario Department of Mines, which appeared only seven weeks after the year had ended—a commendable example of promptness which is all too rare! Figures of the Dominion Bureau of Statistics are given to show the year's production as $577,941,712, but it is anticipated that with final returns it will be possible to raise this total to about $600,000,000—an all-time record. Another record cited in the report is the 57,367 mining claims staked and recorded throughout the province in 1955.

PERSONAL

Mr. D. K. Coutts, M.Sc., A.R.I.C., has been appointed manager of the Technical Office of the Mond Nickel Company Limited in Bombay. He succeeds the late Mr. J. McNeil.

* * *

Mr. T. H. Windibank, C.B.E., M.I.E.E., has resgined from the Board of Crompton Parkinson Limited, as from March 31, 1956. He has been associated with the company for 33 years and has been a director for the past 17 years.

* * *

Mr. Marling J. Ankeny, safety director of the Bituminous Coal Operators' Association, is reported to be the most likely candidate for appointment to the vacant office of Director of the U.S. Bureau of Mines.

* * *

Messrs. J. N. Kiek, F.C.I.S., H. E. Morrel and A. T. Welch have resigned as directors of the Surprise Mining and Finance Co. Ltd. Messrs R. B. Wickenden, F.C.A., G. Heynes, C.A., and P. Edge-Partington, F.C.A., have been appointed to the Board. An Extraordinary General Meeting will shortly be convened to increase the company's ordinary capital from £92,748 16s. to £250,000.

* * *

The National Association of Corrosion Engineers, a U.S. organization, held its 12th anual conference in New York from March 12-16. Direct costs of corrosion amount to approximately $6 billion a year, according to Dr. H. H. Uhlig, of Massachussets Institute of Technology. One oil company reports a cost due to corosion, amounting to $1.5 billion a year.

* * *

The 1956 Coal Convention of the American Mining Congress will be held in Cincinnati, May 7-9. Attention will be focused on ways and means of promoting further operating efficiency, mine safety, lower production costs, and broader coal markets.

* * *

Over 1,300 geophysicists are expected to visit Torono in August, 1957, for the eleventh general assembly of the International Union of Geodesy and Geophysics. The I.U.G.G. is the body which organizes international co-operation in geophysical research.

* * *

Following the recent announcement that Caterpillar Tractor Co. Ltd. will start manufacturing Caterpillar D4 and D8 crawler tractors in the U.K. in 1958, comes the news that Mr. G. E. Spain, vice-president of the company, and the export manager, Mr. J. Q. McDonald, will be visiting Britain to meet the four Caterpillar dealers: Fred Myers Tractor and Equipment Co., H. Leverton and Co. Ltd., Bowmaker (Plant) Ltd., and Caledonian Tractor and Equipment Co. Ltd. Mr. G. Geoffrey Deakin has been appointed marketing manager for Caterpillar Tractor's new British subsidiary.

CONTRACTS AND TENDERS

The International Co-operation Administration (I.C.A.) has announced the following authorizations:

	Contract Period	*Terminal Delivery Date*	*Amount (in U.S. $)*
Taiwan (Formosa)			
Equipment for Coal mine Demonstration Project (PIO/C No. 84-21. 259-9-60132	15/2/56-30/8/56	30/12/56	100,000
Spain			
Aluminium and aluminium base alloys and aluminium products (PA No. 52-691-99-D7-6202	27/2/56-30/4/56	31/7/56	500,000
Construction, Mining and Conveying Equipment (PA No. 52-740-99-D7-6201)	27/2/56-30/6/56	31/7/57	21,000

B.O.T. Ref.: EST/7675/56/I.C.A. Telephone enquiries to Chancery 4411, Extension 360.

This information is supplied by the Special Register Information Service of the Board of Trade, Lacon House, Theobalds Road, London, W.C.1.

METALS, MINERALS AND ALLOYS

COPPER.—The London Metal Exchange's sharp reaction to Anaconda's changed pricing policy for its Chilean output is probably attributable to a combination of several influences. Immediately, and we imagine primarily, the movement suggests that buyers everywhere foresee lower prices ahead now that larger tonnages of Chilean metal will become deliverable in the States during the second half of this year. In this connection it is worth remembering that something like two-thirds of the whole of Anaconda's production (i.e. 25,000 tons per month) comes from its Chilean properties.

Secondly, there appears to be a growing belief that the period when current supply and demand will come into closer balance is not far off. In this connection the U.S. Department of Commerce predicted last week that supply and demand should be in approximate balance during the second quarter of this year. In particular, U.S. production is expected to rise appreciably in the second quarter as the result of a substantial increase in production at the San Manuel mine in Arizona.

On the one hand this greater optimism regarding the supply position is thus attributable to the increasing world production which can in any event be anticipated during this year, coupled with the disguised increase in production which occurs in any strike free year. Last year something like 145,000 tons of copper were lost through labour disputes which so far have not impeded the industry during 1956. However the popular striking season is still ahead of us. On the consumption side, British and some European consumers (although notably not in France) appear to be continuing to put copper on the market in order to reduce inventories, and, as our Metal Exchange correspondent reports, more stocks of wirebars are believed to have been finding their way on to the London market.

It is salutory to recall that it was less than two years ago that the U.S. Government found it expedient to support the market to the extent of absorbing 100,000 tons of "surplus" Chilean copper, and in consequence to reflect on the rapidity with which sentiment in this market can change. However, although we at last appear to be in sight of a return to somewhat lower copper prices this is no occasion for alarm. Quite aside from the fact that the U.S. stockpile must have considerable arrears to make good on its programme, American producers have in the recent past given convincing proof of their readiness to cut-back domestic production at an early stage in the development of a condition of surplus and our main anxiety is not whether they will be prepared to do so again in a similar situation, but whether they will be inclined to act too precipitately and thus sow the seeds of yet another crisis in supply.

Details are now available of Anaconda's new uniform price formula for its Chilean production. The price is to be based on the average of the bid and asked quotations each day for cash copper on the L.M.E.'s morning session. There will, of course, be a discount off this price for freight and other charges.

As we go to press there is as yet no news of Kennecott's future intention regarding its Chilean copper price. The President of the Kennecott Copper Sales Corporation left for Chile about ten days ago to discuss the situation with Chilean officials and the general expectation seems to be of the early announcement of a policy similar to that adopted by Anaconda.

LEAD.—In the States the demand for lead has been fairly good at 16 c. Although the London price has declined slightly in the past week it would still appear to be profitable to ship Mexican lead to Europe rather than to the States.

The A.B.M.S. reports a sharp rise in stocks at refiners at the end of February, the total being 41,450 s.tons against 32,469 s.tons a month earlier. Shipments of refined lead to domestic consumers in February declined to 39,411 s.tons against 49,746 s.tons in January.

The G.S.A. has sent out its usual monthly telegram requesting offers of domestically-mined lead to the stockpile. As in recent months only token offerings are expected.

TIN.—Malaya's acting chief inspector of mines, Mr. Ian L. Patterson, who has on previous occasions expressed himself in similar terms to those used by his predecessor on the subject of the urgent need for increased tin prospecting activity in the Federation, nevertheless feels that the industry has a healthy future. Speaking in Kuala Lumpur this week he based his optimism on the much increased efficiency of the industry, which would make possible the economic working of a great deal of low grade ground. He could not, he said, see Malaya being "mined out" while more than two-thirds of the country had yet to be opened up.

Both employers and employees in the dispute in the Malayan tin industry have agreed to abide by the findings of a sole arbitrator (the president of the Industrial Court) on the remaining difference at issue between them, namely, the Union's claim for retrospective payment for the weekly rest day back to November, 1954. There is no news yet of any settlement of the go-slow strike at Port Swettenham docks.

Our London Metal Exchange correspondent reports the expectation among many market people that a decision is now imminent in favour of closing the Texas Smelter. Meanwhile, our latest information from Washington, now a week old, is the President's statement that the Inter-Departmental Committee report on this matter had not yet reached his desk. It is thought that the delay in forwarding this report to Congress is due to the White House having as yet been unable to discuss its recommendations with Congressional leaders, which is the normal procedure in advance of formal submission of such reports. In particular, prior discussion of the report would doubtless have to take place with Senator Lyndon Johnson, of Texas, the majority leader in the Senate, who has previously been an opponent of the closing down of the Smelter. Meanwhile, the Indonesian contract expires at the end of this month and the Bolivian contract at the end of April. If all this does not galvanize Indonesia into concluding the final stages of ratification of the I.T.A. many people will be surprised and apprehensive.

ZINC.—Although the U.S. market in high grade zinc is now easier than it has been for a long time, through cut backs in automobile production, this is apparently being offset by a strengthening in the demand for prime western grade at 13½ c. due to increased buying by the steel mills.

The National Lead Company has announced an expansion programme for the die-casting facilities of its Doehler-Jarvis division which will call for 7,500 s.tons of zinc per annum.

ALUMINIUM.—The strength in all aluminium markets in 1955 was a reflection of the general high levels of industrial activity, states Mr. Nathaniel V. Davis, president of Aluminium Ltd., in his annual statement to shareholders. The principal fields of aluminium consumption in 1955 are listed in the following order: transportation equipment for land, sea and air; building and architectural uses; the distribution of electricity and manufacture of electrical equipment; household and commercial supplies; and canning and packaging. Industrial aluminium pipe and fittings were introduced on a wide basis during 1955 and international interest was shown in their potentialities as a competitive replacement for standard iron pipe. It is noteworthy that rising prices, coupled with technical advances, have led to the usage of aluminium in the manufacture of telephone cable circuits. New fields are also being opened up by the success achieved in overcoming the problems formerly associated with jointing techniques.

The capacity of the company's Jamaica alumina plant, which is now operating at the rate of 230,000 tons of alumina per year, is being more than doubled to 543,000 tons per year. Production at the latter rate will be attained early in 1957. It may well be that the seemingly never-ending programme of smelter construction will necessitate still further expansion of alumina facilities. Having regard to the recent statement by the island's Chief Minister that Jamaica is to seek a greater return from bauxite mining operations, it is interesting to note that by 1957, when the present programme of construction has been completed, the investment of Aluminium Limited in Jamaica will amount to approximately $60,000,000. Another point made by Mr. Davis is that notable advances have been made in the treatment for Caribbean bauxites, whereby a significant improvement in operating efficiency has been achieved in Jamaica.

On March 23 Kaiser Aluminium raised its prices of all grades of aluminium pig, ingot, billet and mill products by 1¼ c. per lb. effective March 26—the first increase in the industry since last summer. The new price schedules bring the base prices for standard 99 per cent aluminium pig and ingot to 24 c. and 25.9 c. per lb. respectively. Kaiser's move seems to have been taken without consulting the other two major American producers, but Reynolds and Alcoa subsequently announced similar advances. In view of the rising cost of expansion programmes these very moderate increases are scarcely surprising and should not affect aluminium's position vis-a-vis its principal competitors.

A large question mark is presented by reports from trade sources in Buenos Aires that two purchases were recently made

of Soviet ingot aluminium. The price is said to have been between 32 and 33 c. (U.S.) per lb., delivered Buenos Aires. Payment is believed to have been arranged in London in U.S. free dollars, but the quantities involved are not known. On this slender evidence it would certainly be premature to speculate as to the possible emergence of a significant new factor in the world's aluminium trade, at any rate in the immediate future, but it is known from Mr. Krushchev's speech at the 20th Party Congress in February this year that aluminium occupies a high position in the economic programme of the U.S.S.R., as do titanium and magnesium.

COLUMBITE—TANTALITE.—Separate Bills to extend the purchase programmes to stimulate domestic production of beryl and of columbite-tantalite have been introduced to Congress. Under these Bills, the U.S. purchase programmes for these metals would be extended to June 30, 1961.

DIAMONDS.—The possibility that the U.S.S.R. may become a leading exporter of diamonds is indicated by the recent statement of the Soviet Minister for Geology that diamonds would become an important source of foreign currency to the U.S.S.R. This statement follows the reported discovery of rich diamond fields in the Lena basin, said to have been made accidentally by a Soviet geologist who found naturally polished diamonds about the size of peas embedded in the sand of a river bank. The Minister's statement seems to indicate that a substantial proportion of these "pea-sized" stones are of gem quality.

The interesting reflection arises that, as a major exporter of gem diamonds, the U.S.S.R. would virtually be compelled, in its own interest, to take advantage of the machinery set up for the protection of the free world diamond industry. Contracts providing for the continued sale of uncut diamonds through the central selling organization of the De Beers Group of companies have recently been concluded by the Diamond Corporation with eight large companies producing diamonds in territories in Africa outside the Union of South Africa. Among them is Williamsons Diamonds, of Tanganyika, which, till recently, appeared to be holding out for special terms but has evidently realized the importance of concerted action. Arrangements have also been made for the purchase of all diamonds coming from licensed diggings in Sierra Leone. A wholly-owned subsidiary of the Diamond Corporation has been granted by the Sierra Leone Government the exclusive right to purchase diamonds from licensed diamond buyers and dealers in the territory.

Far-reaching consequences would also result from the production of industrial diamonds and boart in large quantities within the U.S.S.R., particularly since this development would coincide with a heavy increase in the Russian requirements of industrial diamonds, due to expansion in the manufacture of precision tools and instruments. Between 1941 and 1946, the U.S.S.R purchased industrial diamonds from Britain to a total value of £1,500,000 to meet the requirements of rearmament. The possibility of large exports from a country hitherto dependent on importation can scarcely be viewed without anxiety by existing producers, particularly in view of the present uncertainty regarding U.S. stockpiling policy. However, large exports have yet to eventuate.

SILVER.—In 1955 Mexico was once again the world's largest producer of silver. Production totalled 45,000,000 oz., compared with 39,900,000 oz. recovered in 1954. Mexico's largest foreign customer in 1955 was Saudi Arabia, which purchased 17,200,000 oz. Germany came second with purchases of 13,900,000 oz.

The London Metal Market

(From Our Metal Exchange Correspondent)

Market movements have been overshadowed by the continuous fall in the price of copper which brought down the price for forward metal by about £40 in a week. It seems that the combination of a surplus of copper in this country and the recent move by Anaconda (which should supply more copper to America) has caused consumers to reconsider their buying policies. In Europe there has been little interest during the week, and in the U.K. it is believed that more stocks of wire-bars have been put on the market, whilst in America the latest published figures have shown that during recent weeks consumers have been buying rather to replenish their stocks than to cover current orders and can therefore keep out of the market without difficulty.

The result of all this has been a decline in London which has been immediately followed by American customs smelters, and it seems that the movement may go on over the holidays, and most people would not be surprised to see a forward copper price in London of about £375 per ton and a customs smelters' price in the U.S. of 49 c. per lb. If the industry remains strike-free for a few more months it is expected that production will catch up with demand (including the stockpile) and that prices will fall to lower levels, which would still be acceptable to producers in general: also it should not be forgotten that there is a possibility of the U.K. government's selling copper, and if this takes place the downward adjustment will undoubtedly take place more quickly than would otherwise be the case.

The tin market has been active, and, although the actual quotations show very little difference from those of a week ago, the undertone is weaker, as the majority of people feel that a decision on the future of the Texas smelter will be taken in the very near future and that this will be for its closing. The situation in Malaya appears to be more settled, and it is expected that any weaker market will cause the Indonesian Government to lodge the instrument of ratification of the International Tin Agreement more quickly. On Wednesday morning the Eastern price was equivalent to £778½ per ton c.i.f. Europe.

The lead and zinc markets have again been featureless, and although prices have receded somewhat the undertone remains reasonably good, and as long as the U.S. Government continues its price support policy no real decline in the price level is expected.

Closing prices and turnovers for four days are given in the following table :—

	March 22		March 28	
	Buyers	*Sellers*	*Buyers*	*Sellers*
Copper				
Cash	£417	£418	£394½	£395
Three months	£411	£411½	£389½	£390
Settlement	£418		£395	
Week's turnover	3,875 tons		6,675 tons	
Tin				
Cash	£763	£764	£779	£780
Three months	£757½	£759	£770	£772½
Settlement	£764		£780	
Week's turnover	760 tons		705 tons	
Lead				
Current half month	£120½	£120½	£119	£119¼
Three months	£118½	£118¼	£118	£118¼
Week's turnover	2,975 tons		2,425 tons	
Zinc				
Current half month	£100½	£100½	£98½	£99
Three months	£98½	£98¼	£97½	£97¼
Week's turnover	3,675 tons		3,350 tons	

OTHER LONDON PRICES — MARCH 28

METALS

Aluminium, 99.5%, £179 per ton
Antimony—
English (99%) delivered, 10 cwt. and over £210 per ton
Crude (70%) £200 per ton
Ore (60% basis) 23s. 6d./24s. 6d. nom. per unit, c.i.f.
Bismuth (min. 1 ton lots) 16s. lb. nom.
Cadmium 12s. 0d. lb.
Chromium, 6s. 11d. lb.
Cobalt, 21s.lb.
Gold, 249s. 5½d.
Iridium, £29/31 oz.
Manganese Metal (96%-98%) £269 according to quantity
Magnesium, 2s. 4d. lb.
Nickel, 99.5% (home trade) £519 per ton
Osmium, £24/27 oz. nom.
Osmiridium, nom.
Palladium, £8 0s./£8 10s. oz.
Platinum U.K. and Empire Refined £34 0s. oz. Imported £39 0s./£41 0s. oz.
Rhodium, £40/£42.
Ruthenium, £16/£18 oz.
Quicksilver, £86 10s. ex-warehouse
Selenium, 112s. nom. per lb.
Silver, 79d. f.oz. spot and f'd.
Tellurium, 15s./16s. lb.

ORES, ALLOYS, ETC.

Bismuth .. .. 50% 7s. 3d. c.i.f.
40% 6s. 3d. lb. c.i.f.
Chrome Ore—
Rhodesian Metallurgical (semi-friable) 48% £15 2s. 6d. per ton c.i.f.
,, Refractory 45% .. £14 2s. 6d. per ton c.i.f.
,, Smalls 42% .. £12 2s. 6d. per ton c.i.f.
Magnesite, ground calcined .. £28 0s./£30 0s. d/d
Magnesite, Raw (ground) .. £21 0s./£22 0s. d/d
Molybdenite (85% basis) .. 8s. 2½d. nom. per lb. c.i.f.
Wolfram and Scheelite (65%) .. 259s. 0d./264s. 0d. c.i.f.
Tungsten Metal Powder (98% Min. W.) .. 21s. 0d. nom. per lb. (home)
Ferro-tungsten (80%-85%) .. 18s. 0d. nom. per lb. (home)
Carbide, 4-cwt. lots .. .. £39 3s. 9d. d/d per ton
Ferro-manganese, home .. £59 10s. 0d. per ton
Manganese Ore Indian Europe (46%-48%) basis 125s. freight.. .. .. .. 102d./105d. per unit c.i.f.
Manganese Ore (43%-45%) .. 95d./97d. per unit c.i.f.
Manganese Ore (38%-40%) .. 88d./90d. per unit
Brass Wire .. .. .. 3s. 7⅛d. per lb. basis
Brass Tubes, solid drawn .. 3s. 0½d. per lb. basis

THE MINING MARKETS

(By Our Stock Exchange Correspondent)

Markets during the past week were quieter but steady. The Prime Minister's personal warning that savings must be increased and an appeal for better labour-management relations was echoed by a warning from the Chancellor which was taken to mean a hard budget. Since savings are to be encouraged, it is to be hoped that this may in part be brought about by reduction of tax where companies plough back profits for re-equipment and depreciation. This could be particularly applicable to the shipping industry and, of course, mining companies controlled from the U.K.

In the Kaffir market, stagnant conditions prevailed and prices mostly fell back. During the coming week, prolonged holidays are unlikely to produce any startling news and shareholders must await the quarterly results due about April 10. In this respect, it should be emphasized that markets at the moment are thin and the current trend could easily be reversed should occasion warrant.

Among finance houses, the preliminary figures and dividends from Anglo American Corporation and Union Corporation failed to stem the tide. Both companies produced higher profits but the Union Corporation distribution proved disappointing. Stockholders had not expected, and did not receive, a higher payment from Anglo American Corporation. Anglo-French were steadier following digestion of the report which disclosed consistent progress.

Among individual Rand mines there was little of interest and prices fell away. Exceptions to this trend were mostly the older properties which have already suffered substantial falls and where the future outlook had already been discounted. The market reaction to last week's statement by Vogelstruisbult has proved one of caution and there have been continued rumours of unsatisfactory developments emanating from Johannesburg.

In the Orange Free State section, share prices also declined and there was little active interest. Free State Geduld at one time rallied to 83/9d. but quickly lost ground again. Recent rumours that the development drive into Western Holdings had been holed are incorrect as the chairman stated at the last meeting that this would probably be completed towards the end of June. Elsewhere, bear operations lowered most of the favourite counters.

There was a little more interest shown in Australian gold mines. Gold Mines of Kalgoorlie maintained their distribution and buyers appeared for Lake View and Star. Most of the other issues gained the turn.

Diamond shares also followed the lower trend and prices in this case were influenced by the fact that no tax concessions were made to the industry in the Union Budget.

Copper shares encountered profit-taking following the break in the metal price in the United States. This, in turn, was thought to be caused by high metal inventories and reports that aluminium might be used as a substitute. Chartered were, however, a good market since the company is unlikely to suffer loss from the policy of the Rhodesian Selection Group in selling metals to consumers below current market prices. Chartered must also have benefited considerably from the recent peak value. Rhodesia Katanga rose in anticipation of the coming report but later fell back sharply. Rhodesian Selection dropped in consequence of the Chartered royalty decision.

Eastern tin shares were little affected by the news that the Texas smelter may be closed. There was, however, considerable interest in the companies that have strong liquid positions and which it is thought may repay capital in the same manner as Tanjong. In this connection, Kent F.M.S. and Kinta Tin were outstanding. Kamunting rose on news that the second dredge in Siam has come into operation.

There was considerable interest in the Canadian Government decision to free gold dealings in Canada and reports that they are also contemplating the minting of gold coins. International Nickel hardened on press rumours of a higher metal price during the current year. Some 9,000 s.tons of nickel have recently been released from the United States stockpile.

Finance	Price Mar. 27	+ or — on week
African & European	2 11/16	— 1/16
Anglo American Corpn.	8 1/2	— 1/4
Anglo-French	19/3	—6d
Anglo Transvaal Consol	28/1 1/2	.....
Central Mining (£1 shrs)	39/-	—1/-
Consolidated Goldfields	56/9	—9d
Consol. Mines Selection	32/6	—1/3
East Rand Consols	1/7 1/2	—1 1/2d
General Mining	4 1/2	— 1/16
H.E. Prop.	8/-	.....
Johnnies	37/3	—1/6
Rand Mines	3 1/16	— 1/16
Rand Selection	40/-	—7 1/2d
Union Corporation	37/9	—1/3
Vereeniging Estates	4 1/16	— 1/16
Writs	34/4 1/2	—7 1/2d
West Wits	38/6	—9d
Rand Gold		
Blyvoors	24/3	—9d
Brakpan	6/6	—6d
Buffelsfontein	26/3	—1/-
City Deep	9/9	+3d
Consol. Main Reef	19/4 1/2	.....
Crown	2 1/16	— 1/16
Daggas	2 1/16	— 1/16
Dominion Reefs	20/3	—9d
Doornfontein	22/-	—6d
Durban Deep	29/4 1/2	—1/3
E. Champs	4/-	.....
E. Daggas	9/3	—3d
E. Geduld (4s. units)	34/3	.....
E. Rand Props.	2 1/16	— 1/16
Geduld	4 1/16	.....
Govt. Areas	5/-	—3d
Grootvlei	20/9	—6d
Hartebeestfontein	36/3	—1/-
Libanon	7/3	—3d
Luipaards Vlei	15/9	—6d
Marievale	20/3	—3d
New Kleinfontein	5/-	—3d
New Pioneer	14/6	—3d
Randfontein	47/3	—2/-
Robinson Deep	14/3	—6d
Rose Deep	10/3	.....
Simmer & Jack	4/-	.....
S.A. Lands	20/7 1/2	—7 1/2d
Springs	2/7 1/2	—3d
Stilfontein	24/9	—9d
Sub Nigel	31/10 1/2	—1/3
Vaal Reefs	30/6	—1/6
Van Dyk	3/1 1/2	—1 1/2d
Venterspost	13/6	.....
Vlakfontein	16/6	—1/-
Vogelstruisbult	19/6	.....
West Driefontein	5 1/16	— 1/16

Rand Gold contd.	Price Mar. 27	+ or — on week
W. Rand Consolidated	38/9	—7 1/2d
Western Reefs	31/3	—1/3
O.F.S. Gold		
Freddies	7/7 1/2	—11d
Freddies Consolidated	4/3/5	—3d
F.S. Geduld	3 1/16	— 1/16
Geoffries	12/3	—6d
Harmony	25/6	—10 1/2d
Loraine	5/6	—4 1/2d
Lydenburg Estates	16/9	—9d
Merriespruit	10/6	—6d
Middle Wits	12/4 1/2	—3d
Ofsits	57/-	—2/3
President Brand	60/7 1/2	—2/6
President Steyn	31/9	—1/9
St. Helena	26/3 XD	—9d
Virginia Ord.	10/6	—6d
Welkom	21/6	—1/-
Western Holdings	3 1/2	— 1/16
West African Gold		
Amalgamated Banket	1/9	.....
Ariston	5/11	—11d
Ashanti	18/10 1/2	—4 1/2d
Bibiani	3/4 1/2	.....
Bremang	1/4 1/2	.....
G.C. Main Reef	2/1 1/2	.....
Kononga	1/10 1/2	.....
Marlu	1 1/2d	.....
Taquah	1/4 1/2	.....
Western Selection	7/9	—3d
Australian Gold		
Gold Mines of Kalgoorlie	13/-	+4 1/2d
Great Boulder Prop.	11/3	+3d
Lake View & Star	16/7 1/2	+7 1/2d
Mount Morgan	23/11 1/2	+11d
North Kalgurli	7/11	+4 1/2d
Sons of Gwalia	2/10 1/2	.....
Western Mining	10/-	+6d
Miscellaneous Gold		
Cam & Motor	8/9	.....
Champion Reef	4/3	—11d
Falcon Mines	7/4 1/2	.....
Globe & Phoenix	25/9	.....
Motapa	1/11 1/2	.....
Mysore	2/3	—1 1/2d
Nundydroog	6/3	.....
St. John d'El Rey	19/-	—1/-
Zams	58/11 1/2	.....

Diamonds and Platinum	Price Mar. 27	+ or — on week
Anglo American Inv.	8 1/2	— 1/2
Casts	24/-	—9d
Cons. Diam. of S.W.A.	8	.....
De Beers Defd. Bearer	5 1/2	— 1/16
De Beers Pfd. Bearer	15	.....
Pots Platinum	12/-	.....
Watervaal	19/-	.....
Copper		
Bancroft	41/6	+2/3
Chartered	76/6	+1/6
Esperanza	3/9	.....
Messina	10 1/2	— 1/16
Nchanga	15 1/16	— 1/16
Rhod-Anglo-American	6 1/16	— 1/16
Rhod-Katanga	29/6	—1 1/2
Rhodesian Selection	54/9	—3/3
Rhokana	43	—2 1/2
Rio Tinto	3 1/4	.....
Roan Antelope	30/-	—3d
Selection Trust	4 1/16	— 1/16
Tanks	8 1/16	— 1/16
Tharsis Sulphur Br.	4 1/2	.....
Tin (Eastern)		
Ayer Hitam	21/9	+3d
Gopeng	9/4 1/2 XD	+1 1/2d
Hongkong	7/1 1/2	.....
Ipoh	23/-	.....
Kamunting	9/6	+3d
Kepong Dredging	2/9	+1 1/2d
Kinta Tin Mines	18/-	+3d
Malayan Dredging	9/10 1/2 XD	.....
Pahang	12/4 1/2	—3d
Pengkalen	11/-	.....
Petaling	8/7 1/2 XD	+1 1/2d
Rambutan	25/-	.....
Siamese Tin	9/-	—1 1/2d
Southern Kinta	15/7 1/2 XD	.....
S. Malayan	8/3 XD	.....
S. Tronoh	7/1 1/2	.....
Sungei Kinta	15/6	.....
Tekka Taiping	8/7 1/2	.....
Tronoh	9/3	+1 1/2d
Tin (Nigerian and Miscellaneous)		
Amalgamated Tin	11/1 1/2	.....
Beralt Tin	38/6	—6d
Bisichi	5/10 1/2	.....
British Tin Inv.	22/6	—3d
Ex-Lands Nigeria	2/7 1/2	.....
Geevor Tin	15/4 1/2	—6d

Tin (Nigerian and Miscellaneous) contd.	Price Mar. 27	+ or — on week
Gold & Base Metal	1/6	.....
Jantar Nigeria	5/7 1/2	.....
Jos Tin Area	12/3	.....
Kaduna Prospectors	1/9	.....
Kaduna Syndicate	2/7 1/2	—1 1/2d
London Tin	9/7 1/2	+3d
United Tin	1/7 1/2	.....
Silver, Lead, Zinc		
Broken Hill South	59/6	+1/-
Burma Corporation	3/10 1/2	+3d
Consol. Zinc	53/6	+2/-
Lake George	14/6	—6d
Mount Isa	21/4 1/2	+2/10 1/2
New Broken Hill	45/3	+1/-
North Broken Hill	4 1/2	.....
Rhodesian Broken Hill	12/1 1/2	—3d
San Francisco Mines	25/9	+9d
Uruwira	5/4 1/2	—3d
Miscellaneous Base Metals and Coal		
Amal. Collieries of S.A.	49/3	+6d
Associated Manganese	38/9	+9d
Cape Asbestos	9/6	+3d
C.P. Manganese	31/3	+3d
Consol. Murchison	63/1 1/2	—2/6
Natal Navigation	3 1/16	+ 1/16
Turner & Newall	100/6	+1/6
Wankie	16/7 1/2	—1 1/2d
Witbank Colliery	4 1/8	— 1/8
Canadian Mines		
Dome	$28 1/4	+1 1/4
Hollinger	$49	—3
Hudson Bay Mining	$127	—1
International Nickel	$168	+3 1/2
Mining Corpn. of Canada	£10 1/4	+ 1/4
Noranda	$114 1/2	—1 1/2
Quemont	£10 1/2	+ 1/2
Yukon	4/7 1/2	+3d
Oil		
Apex	31/6	+1/-
Attock	40/6	—9d
British Petroleum	5 1/4	+ 1/16
Burmah	3 1/8	+ 1/16
Canadian Eagle	56/6	+1/-
Mexican Eagle	21/6	—1 1/2d
Shell	7 1/8	+ 1/8
Trinidad Leasehold	36/6	+9d
T.P.D.	36/-	+6d
Ultramar	36/9	+3d

COMPANY NEWS AND VIEWS

Aluminium Ltd.'s Record Year

New records of production, sales and profits were advised by Aluminium Limited together with its subsidiaries in Canada and abroad during the year ended December 31, 1955. Sales and operating revenues brought in $412,000,000 compared with $328,000,000 during 1954. Net income after depreciation and dividends on deferred shares of subsidiaries totalled $48,193,952 ($34,970,025). Earnings of $4.83 on the 9,975,690 shares outstanding compared with $3.87 per share on 9,036,382 shares previously.

Despite an interruption of power deliveries to Aluminium Company of Canada's Kitimat smelter during the early part of the past year, and a severe water shortage in the Saguenay area of Quebec in the latter part of the year, production of primary aluminium in Canada increased to 607,700 s.tons from 560,900 s.tons in 1954. In his comments to shareholders, the president of Aluminium Ltd., Mr. Nathaniel V. Davis, emphasized that had operations been able to maintain capacity levels during 1955, both production and sales would have been approximately 6 per cent above their actual levels. Correspondingly—or slightly larger—increases in profits would have resulted.

Unfortunately, Mr. Davis continued, curtailment of production and deliveries has extended into the current year. As a result of water shortages output has been sharply cut but should return to normal after the Spring break-up in April. Having regard to the lag between production and sales, financial results for the six months ending June 30, 1956, would be burdened with production losses sustained in early months.

Anglo American Pays 50 Per Cent Final

With the recommendation of a final dividend amounting to 50 per cent on its £3,917,671 ordinary capital in 10s. shares, The Anglo American Corporation of South Africa has maintained distribution in respect of the twelve months ended December 31, 1955, at the same level as that of the previous year. Subject to final audit, profits after tax were sharply increased to £5,048,000 from £4,028,257. A sum of £1,000,000 (£1,100,000) was placed to general reserve. In addition £500,000 was appropriated against loans and £549,000 written off investments. Sir Ernest Oppenheimer is chairman.

American Metal's Bumper Income

Net operating income of American Metal Company for the year ended December 31, 1955, jumped to $11,694,401 from $4,197,348 in respect of the preceding year. Dividends received moved up to $15,346,600 from $11,447,103. Total net income after tax of $19,809,694 compared with the 1954 figure of $10,826,515. Common dividends were raised to $3 ($1.75) with a 5 per cent stock payment.

Basis For New Copper Royalties

Following last week's announcement by Mr. Hely-Hutchinson, president of The British South Africa Company, that a new basis for payment of copper royalties by Northern Rhodesian producers had been introduced (see *M.J.*, page 371), Chartered has now published details of this new basis which are as follows.

As soon as possible after the end of each calendar month there is ascertained the average for the month of the quotation for standard (electrolytic) copper for cash (mean) and the average for the month of the quotations for standard (electrolytic) copper three months (mean) as quoted by the London Metal Exchange. The arithmetical mean of the averages as ascertained, less 10 per cent of such arithmetical mean, is used as the basis for the valuation for royalty purposes of copper produced during that month. The amount of royalty payable in respect thereof is 5 per cent of the value so ascertained, plus 10 per cent of so much of that value as may exceed £80 per ton of copper.

Falcon Intersects Central Orebody

Speaking at the meeting of Falcon Mines held at Bulawayo earlier this week, Mr. E. B. Papenfus made some interesting remarks (see page 405) in addition to those in the statement which he had previously circularized to shareholders. Tonnage at Dalny Mine, he said, during five months since Sepetmber 30, 1955, had risen from a monthly average of 13,550 tons during 1954/55 to 15,900 tons last February. Working profit for Dalny Sunace and Bay Horse Mines during this period, excluding additional revenue from sales of gold, had been £46,983.

Since the close of the past financial year some very satisfactory development results had been obtained at Dalny. Of 4,084 ft. advanced, 1,300 ft., equal to 58 per cent, had been payable averaging 7.6 dwt. over 64 in. Moreover, within the last few days the central orebody on the 13th level had been intersected. The average reduced value of these intersections was 4.5 dwt. over 100 in. As these exposures were five levels below the lowest stoping, and three levels below the mine's lowest development on the 10th level, the results were regarded as most encouraging.

Ariston's Deep Level Development Plans

A fall in mill grade at Ariston Gold Mines (1929) during the year ended September 30, 1955, was offset by a greater mill throughput. Gold recovered thus increased, while costs showed a decline from the previous year's level.

Year to Sept. 30	*Tons Milled* (000)	*Cost per ton* s.	d.	*Gold recovered dwts. per ton*	*ozs.* (000)	*Dev't ftge.* (000)	*Ore Reserves** (000)
1955	455.7	13	10	6.6	132.6	7.8	2,156.0
1954	398.8	14	1	7.3	130.9	3.6	2,397.6

* Value 6.66 dwts. over 112 inches. (1955A - 6.77 dwts. over 117 inches.)

In order to conserve finances which, since the end of the past financial year have been severely depleted by the strike of African labour on the Gold Coast, the company decided that no final dividend should be declared. Accordingly total distribution at 10 per cent on the issued ordinary capital of £1,125,000 in stock units of 2s. 6d., represented a sharp drop from the previous year's figure of 30 per cent.

Year to Sept.30	*Total Revenue* £	*Taxation* £	*Net Profit* £	*Dividend* £	*To Reserve* £	*Carry Forward* £
1955	1,662,821	174,178	206,274	64,687	130,000	80,297
1954	1,626,194	235,181	170,251	185,625	nil	78,710

One or two interesting technical features emerge from a study of the report. Firstly, the past year's drop in mill grade is explained as being mainly due to a stage in underground development being reached which does not permit elasticity in the extraction of ore, but this position will soon be remedied by a programme of deep level development. Some encouraging details regarding improvement in working efficiency have been given. Tons milled per African shift during 1954/55 rose to over 80 per cent of the base index established in 1950. The significance of this gain was that an additional 56,880 tons could be milled with no increase in African shifts worked.

Ariston's consulting engineers are in the process of preparing a comprehensive long-term scheme of development on the Main No. 2 and North Orebodies at depth, and to the south in the Gamma Shaft area towards the properties of Gold Coast Main Reef. Fuller details of this programme will be announced as soon as possible. Meanwhile, although ore reserves suffered a slight decline during the past year, the tonnage available represents some 4.48 years ahead of the mill at the estimated milling rate of 40,000 tons a month. An increase in development footage, is however, necessary in order to stabilize reserves at or about the present figure.

At their present price of around 5s. Ariston 2s. 6d. shares yield about 5 per cent—a low return which presupposes a swift revival in the dividend rate. Major-General W. W. Richards is chairman. Meeting London, April 10.

Konongo Pays 25 Per Cent Final

A final dividend of 25 per cent on Konongo Gold Mines' ordinary capital of £309,629 has been announced in respect of the year ended September 30, 1955. An interim of 5 per cent was previously paid on a capital of £619,258 prior to the return of 1s. per 2s. share last November. Subject to audit, profits advanced to £83,056 from £59,694. This figure was struck after depreciation of £15,355 (£16,769); taxation of £113,000 (£103,250) and writing nil (£10,628) off obsolete and surplus stores. The balance carried forward was £84,457 against £63,714. Owing to the recent strike of African employees, operating results for the current financial year do not, it is stated, justify the declaration of an interim dividend at the present time. Mr. R. Annan is chairman. Meeting, May 8.

Esperanza's Nine Month's Profits

Estimated mine operating profit of Cyprus Copper & Sulphur Company—the subsidiary of Esperanza Copper & Sulphur Company—during nine months ended December 31, 1955, amounted to £124,557. During the company's financial year ended March 31, 1955, trading profits amounted to only £8,560. So far present disturbed conditions in Cyprus have not interfered with output and ore mined in the nine months amounted to 36,720 tons from Kinousa and 90,510 tons from Limni. Total shipments for this period were 46,530 tons of Kinousa ore and 7,770 tons of pyrites concentrates from the Limni Mill.

Arrangements for the issue of £200,000 5½ per cent convertible debenture stock 1960-65 by Esperanza have been completed. This is to be subscribed at par by Lazard Bros., British Metal, Robert Fleming and London Tin. The Board of Esperanza has been reconstituted to include representatives of these companies. The appointment of Mr. William Mure, Mr. J. Ivan Spens and Mr. W. M. Warren will therefore be considered at the next annual meeting. Mr. J. Ivan Spens has already been appointed chairman of the company in succession to Mr. A. Hedley Williams.

Anglo-Burma's Lower Output

Total production from all sources, excluding Thabawleik, by the Anglo-Burma Tin Company during the year ended May 31, 1955, fell to 96.65 tons from 107.03 tons in the previous year. Although there was some decrease in the number of insurgent incidents in the Tavoy District, the improvement was insufficient to enable senior staff to resume plant operations at the Heinda mine. Tribute working, therefore, continued at Heinda, but as anticipated, these operations became increasingly difficult and output fell to 73.45 tons of tin concentrates from 103.26 previously. Every effort was made to obtain tribute production from the company's other areas, while 15.39 tons of concentrates were received from Onzinchaung as against only 3.77 tons previously. At Shanthe—where tribute operations were resumed in July, 1954—a total of 7.81 tons was produced.

Written down value of fixed assets at May 31, 1955, totalled £101,391, compared with £112,898 representing the preceding year's revised figure. Current assets totalled £86,450 (£92,642) against current liabilities and reserves for future taxation of £19,921 (£18,510). Anglo-Burma increased its loss to £19,110 during the past twelve months from the previous year's figure of £3,676. A total debit balance of £18,669 (£441) was carried forward. Mr. F. R. Cottell is chairman. Meeting, London, April 11.

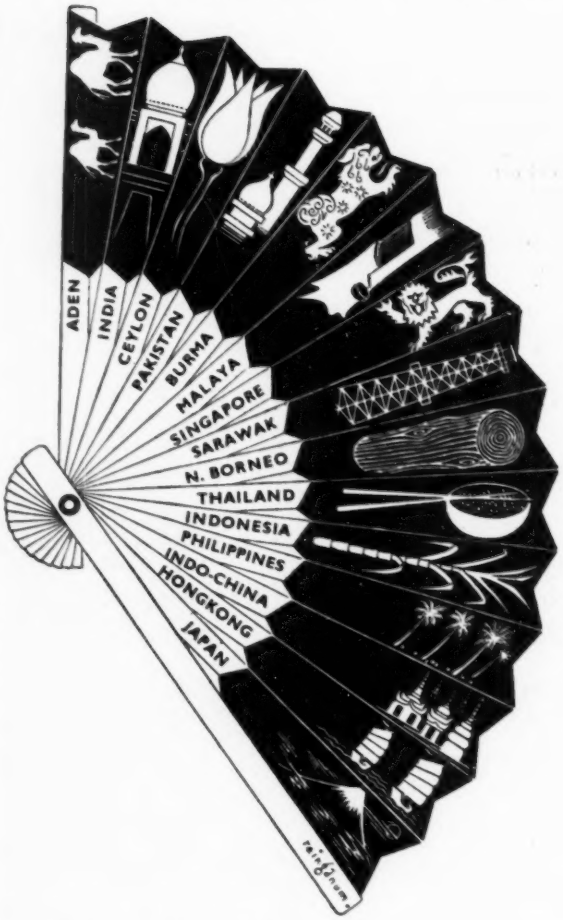
Tanjong Receives £300,000 From Lower Perak

Tanjong Tin Dredging has received a sum of £300,000 from Lower Perak Tin Dredging for its Sungei Luas leases. The company accordingly proposes to distribute a special 100 per cent tax free capital dividend. This will absorb £185,834. An extraordinary meeting to authorize this payment will be held on April 5.

RECENT INTERIM DIVIDEND ANNOUNCEMENTS

Company	*Year ending*	*Dividends*	*Date payable*	*This year to date*	*Total last year*
		%		%	%
Wankie Coll.	31. 8.56	3¾	May 17	3¾	8¾
Petaling Tin(*a*)	31.10.56	7½	Mar. 27	7½	85
Gopeng Cons.(*b*)	30. 9.56	10	Mar. 27	10	30
Malayan Tin(*c*)	30. 6.56	6⅞	April 30	13¼	26⅜
S. Malay Tin(*d*)	30. 6.56	6⅞	April 27	13¼	32.67
Globe & Phoenix(*e*)	31.12.56	30	April 17	30	60
Falcon Mines	30. 9.56	7½	May 10	7½	17½
Tronoh Mines	31.12.56	7½	April 13	7½	(*f*)
Kinta Tin	31.12.56	10	Mar. 29	10	(*g*)
Tanjong Tin	31.12.56	30	April 5	30	(*h*)
Ayer Hitam(*i*)	30. 6.56	10	April 19	20	100
Sungei Besi	31. 3.56	10	April 17	30	40
Rho Anglo(*j*)	30. 6.56	20	May 10	20	77½
Rhokana Corp.(*j*)	30. 6.56	75	May 10	75	262½

(*a*) 1954/55 - Four interims and one final
(*b*) 1954/55 - Four interims
(*c*) 1954/55 - 26¾ per cent calculated on increased capital £900,000
(*d*) 1954/55 - 32.67 per cent calculated on increased capital £1,441,667
(*e*) 1955 - " First interim " - one interim 60 per cent only
(*f*) 1955 - Five interims to date total 40 per cent
(*g*) 1955 - Four interims to date total 55 per cent
(*h*) 1955 - Four interims to date total 75 per cent
(*i*) 1955 - 100 per cent on old capital of £180,000
(*j*) Latest dividend net - after Rhodesia tax



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SUBSTANTIAL CONTRIBUTION TOWARDS RHODESIAN HYDRO-ELECTRIC SCHEME

COMPANY'S ROLE IN DEVELOPMENT OF FEDERATION

MR. C. HELY-HUTCHINSON ON VALUATION OF COPPER FOR ROYALTY

The 58th Annual Meeting of the British South Africa Company was held at The Chartered Insurance Institute, 20 Aldermanbury, London, E.C.2, on March 22.

Mr. C. Hely-Hutchinson (President) who presided said :—

Before we begin our formal proceedings it is fitting that we should now record in the Company's annals the death of our late President, Sir Dougal Malcolm, on the 30th August, 1955. We, on this side of the table, mourn the loss of a colleague whose admirable personality, great experience and human sympathies have for so long enlightened our work. His services to the Company during his 42 years' association with its affairs have been notable indeed. He joined the Board in 1913 when 36 years old having already played an important part in great affairs which included among other matters a share in the building of the Union of South Africa. The Company, at that time, in pursuance of the powers entrusted to it 24 years earlier in the Charter given to it by Her Majesty Queen Victoria, was administering the territories in Northern and Southern Rhodesia which it had, under those same powers, occupied and added to Her Majesty's domains. He was admirably fitted both by experience and inclination to share in that work and when some ten years later, the Company handed over its administrative functions in Northern Rhodesia to the Crown, and in Southern Rhodesia to the Southern Rhodesian people his gifts of clear thinking and lucid expression were effectively applied to the clarification of the difficult problems related to that transfer and to securing for the Company a reasonable settlement of them.

A VULNERABLE SITUATION

The Company emerged from that settlement, as you will remember, as admitted owners of the mineral rights and of the railways in both territories. A vulnerable situation as events have proved.

In the subsequent sale by the Company of its mineral rights in Southern Rhodesia in 1933, of its ownership of the railways in both territories in 1947, and in the conditional termination in 1986, of its ownership of the mineral rights in Northern Rhodesia which last was settled in 1950—all three of which negotiations had to be undertaken as the result of the pressure of public opinion—the main burden of defending the Company's interests was borne by him.

For the last 18 years of his association with the Company—since 1937—he was our President and by his personal eminence and the esteem in which he was held by his friends and contempories in Rhodesia as well as in England shed lustre on that office and enhanced the credit of the Company. You will feel sympathy with his widow who in the evening of her life no longer has the comfort of his companionship.

PRESIDENCY AND VICE PRESIDENCY

You will observe from the list of Directors that my colleagues have invited me and I have agreed to succeed Sir Dougal Malcolm as President of the Company. I hope that my long association with the Company's business, since 1925, when I became a member of the Board, will help me to discharge the functions of that office to the satisfaction of my colleagues and to the advantage of the Company.

We thought it desirable, at this juncture, to revive the office of Vice President, last held by the late Baron Emile d'Erlanger, uncle of our colleague, Mr. Leo d'Erlanger. We have appointed to that office Colonel Sir Ellis Robins, who joined the Company as General Manager in Rhodesia in 1928 and has been a member of the Board, and the Company's Director resident in Rhodesia since 1934. Sir Ellis Robins has, as you must know, created for himself a unique personal position in Rhodesia and has as well the distinction which, in this case, could not be more suitable, of being one of the first Rhodes Scholars. The care of the Company's business in Rhodesia has been in his efficient hands now for 28 years, during the whole of which he and I have worked together with amity and mutual goodwill. His appointment as Vice President is an acknowledgment of the valuable services which he has given to the Company. Sir Ellis Robins visits us here at regular intervals, and as you will remember, the late President made frequent visits to Rhodesia. I have arranged to go there next month. Meanwhile our colleague, Mr. Emrys-Evans has recently returned from a journey in the course of which he has renewed personal touch with Rhodesian affairs and people.

REPORT AND ACCOUNTS

The Report and Accounts have been in shareholders' hands for some time. The figures in the Profit and Loss Account and in the Balance Sheet, are materially in the usual form and supplemented by the more ample information contained in the Directors' Report are, I hope, self-explanatory. You will, therefore, perhaps be grateful if I should omit the customary itemised commentary upon them. There will after all be an opportunity later on in these proceedings for anyone present to ask for any further information or explanation which he may want to have. I shall, however, discuss some of the more interesting subjects.

MINERAL REVENUE FOR YEAR TO SEPTEMBER 30, 1955

The Mineral Revenue for the year, as you will see in the Profit and Loss Account, amounted to £10 M after providing for the share of 20% thereof which is payable to the Northern Rhodesian Government in accordance with the 1950 Agreement. 96% of this was from copper of which 340,000 tons were produced and were valued for royalty purposes at an average of £289 per ton, which compared with an average of £210 per ton for the previous year.

FUTURE MINERAL REVENUE

Copper is currently being produced in Northern Rhodesia at the rate of 32,000 tons a month which is at an annual rate of 384,000 tons subject of course to the effect of any strikes or coal shortages which may occur.

The value per ton for royalty purposes is, at present, over £380 though it may be unwise to base calculations too long ahead upon a continuity of that value.

In addition the Chibuluma Mine should soon be producing copper at an annual rate of 16,000 tons and as from the beginning of 1957 Bancroft Mines should be producing copper at an annual rate of nearly 45,000 tons which they plan to double in 1960.

Upon such figures as these may be based a variety of differen; calculations of future revenue—more or less rosy in proportion to the views of the calculator. The less optimistic may like to be reminded that a reliable observer has as recently as in November last year recorded that in the view of the copper industry collectively the price of Electrolytic Copper is not likely to fall much below £240 a ton in the foreseeable future. On the basis of an annual production rate of only 400,000 tons, at that price, the Company's net annual income from all sources, after tax, calculated at current rates, is not likely to be far short of £4 M.

These are comforting thoughts but there is a matter bearing upon them of which you should be made aware.

VALUATION OF COPPER FOR ROYALTY

You may remember that when in May of last year the Rhodesian Selection Trust announced its policy of selling copper at fixed prices there followed some speculation in the newspapers as to whether it would affect our royalties on the copper so sold. In the following July we published a statement which recorded that:—

"The question of the basis on which the Company's royalty on copper should be calculated in the future has for some time been—and still is—under discussion between The British South Africa Company and the R.S.T. Group. It is also the subject of confidential discussion between the Company and their legal advisers and, in the circumstances the Company feels that it must refrain from making any further statement on the subject at the present time." That was the announcement made in July, 1955.

Those discussions both with the Rhodesian Selection Trust and our Lawyers continued thereafter and meanwhile, the

Copper Companies continued to pay royalty upon the copper produced by them on an agreed provisional valuation basis. At the end of the year, no agreement with the Rhodesian Selection Trust having by then been reached, and having in the meanwhile been finally advised by our Lawyers as to our contractual rights, we unilaterally fixed a new basis of valuation and required the Copper Companies to adjust accordingly the royalties which had already been paid on the agreed provisional valuation basis and to pay royalty in future upon the new valuation basis so fixed.

I might here explain that we had to take into account the change which the London Metal Exchange has made in the basis of its quotations for copper. Before the war the London Metal Exchange quotation was for a ton of rough copper and that had been adopted in our contracts with the Copper Companies as the basis for valuing copper for royalty. The London Metal Exchange closed down in 1939 and temporary arrangements for valuation were made. When the London Metal Exchange resumed business in 1953 and we sought to return to the use of its quotations we had to make provision for the fact that its quotation was then for a ton of Electrolytic Copper—a more valuable product than Rough Copper. Our contracts with the Copper Companies gave us the right in certain events to substitute similar standards of valuation to those prescribed in them and we had to settle what, under those circumstances was a similar standard of valuation. Apart from that the Rhodesian Selection Trust had taken the view that the London Metal Exchange quotation ought not to be the sole basis for valuing copper for royalty.

Since we thus fixed unilaterally the new basis of valuation all the Copper Companies have conformed to our requirements as to the payment of the royalties calculated in accordance therewith. The Companies under the direction of the Rhodesian Selection Trust have reserved a right to challenge the correctness of that basis but without any consequential right to readjust retrospectively any payments which it may have made or may make in the future accordance therewith. The Companies under the direction of Rhodesian Anglo American have not challenged the correctness of that basis but have reserved the right to claim the benefit of any different basis of valuation which we may hereafter apply to the Rhodesian Selection Trust Companies. This of course is reasonable enough.

INVESTMENTS

You will also see, in the Profit and Loss Account, that the revenue from investments amounted to £1,800,000; three-quarters of that total was derived from Rhodesian Mining Investments. The total Book Value of investments including subsidiary companies as shown in the Balance Sheet was £16½ M and exceeded the comparable total at the end of the previous year by £1,400,000. The Market Value at September 30, 1955, of the quoted investments (including £3.8 M for the shares in the Rhodesia Railways Trust) was £29 M to which could be added £11 M for the value of the unquoted investments (which include the Mufulira and New Rhodesia Investment holdings)—a total of £40 M. The Market Value of those same investments as at March 15 last was £39 M.

CURRENT NET ASSETS AND COMMITMENTS

Finally let us examine the Company's financial position.

At the date of the Balance Sheet the Assets other than Fixed Assets and Investments, i.e. the addition of the two items called "Unclaimed Dividend Fund" and "Current Assets" totalled £12.2 M.

The liabilities other than Capital and Reserve, i.e. the addition of the four items called Future Taxation, Staff Superannuation, Unclaimed Dividends and Current liabilities, including the proposed final dividend totalled £11.2 M. Thus there was a net surplus of Assets of £1 M but there were commitments of various sorts amounting in all to over £5 M. These include provision for the important commitments which, as reported to you at the last Annual Meeting, we have undertaken in respect of the finance of Bancroft Mines.

Moreover, since the close of the financial year, we have undertaken, as was foreshadowed in principle when we last met, and as was reported in the Press a month ago, to lend to the Government of the Federation of Rhodesia and Nyasaland over the next four or five years a total of £4 M towards the monies—now estimated at £79 M as compared with the estimate of £54 M a year ago—required to carry out the first stage of the Hydro Electric Installation at the Kariba Gorge. The loan is to earn interest on the same terms, whatever they may be, as may be required by the International Bank in respect of such monies as it may find for the same purpose.

We have no doubt that this substantial contribution towards the finance of this important undertaking is fully justified not only because, as a source of power, it will greatly benefit the Northern Rhodesian copper producing industry with whom our own fortunes are so closely identified but because we have an inescapable obligation to play our part in the development of the territories from which we draw the greater part of our large revenues. That same obligation may well involve us in other similar commitments in future years.

We thus had commitments totalling some £8 M in excess of the nett cash resources. Their chronological incidence is such that we have no reason to doubt, on any reasonable forecast of our future profits, that we shall be able to meet them as they mature and at the same time to maintain the dividend at the annual rate recommended to you to-day.

DIVIDENDS

The gross amount required to pay that annual rate of dividend in respect of the year ended September 30, 1955, and to meet the distributed Profits Tax on the profit so distributed will be £4¼ M or 40% of the gross profit before tax (which was £11.8 M). Of that gross profit, taxes, other than the distributed Profits Tax will absorb 32%, and 28% will be carried forward.

The amount thus carried forward will contribute to the fortification of the Company's resources necessary to enable it to discharge the commitments already undertaken, and to put it in a position to assume any new commitments which it may be thought proper to take, not only to help in the future development of the Federation, including of course the search for minerals with a view to the establishment of new sources of royalty revenue, but also in pursuance so far as may seem fit, of the investment policy outlined to you by my predecessor last year.

The Report and Accounts were unanimously adopted and the dividend of 30 per cent for the year was approved.

The retiring directors, Sir T. Ellis Robins, K.B.E., D.S.O. (Vice-President), and Mr. A. Comar Wilson, were re-elected and the other formal business duly transacted.

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FALCON MINES

MR. E. B. PAPENFUS'S ADDITIONAL REMARKS

The Forty-Sixth Annual General Meeting of Falcon Mines, Limited, was held on March 27 at Exchange Buildings, Bulawayo, Southern Rhodesia.

Mr. E. B. Papenfus, Chairman, presided, and in moving the adoption of the report and accounts, said:—The Directors Report and Accounts for the year ended September 30, 1955, together with my review, have been in your hands for some time and are now before you. The affairs and operations of the Company during the year under review are fully dealt with in the report and review and it is therefore only necessary for me to supply you with the results of operations since the close of the financial year.

MINING RESULTS

The tonnage milled at the Dalny Mine for the five month period since September 30, 1955, was 74,400, which yielded 13,217 ounces fine of gold, equal to a recovery of 3.55 dwt. per ton milled. The working profit at the mine for the period, based on a selling price for gold of 245/6d. per ounce, was £43,377. In addition £1,009 accrued from sales of gold at prices above 245/6d. per ounce in respect of gold produced for the three months ended December 31, 1955. You will no doubt have noted the gradual rise in tonnage milled from a monthly average of 13,550 tons during 1954/5 to 15,900 tons for last month.

The Dalny Mine development results since the close of the year have also been very satisfactory. The total footage advanced was 4,084, of which 2,235 feet were sampled and 1,300 feet equal to 58% were payable, averaging 7.6 dwts. over 64 inches. Within the last few days the central ore-body on the 13th level has been intersected in one crosscut and three boreholes, covering a strike length of 155 feet, and the average reduced value of these intersections is 4.5 dwt. over 100 inches. In view of the fact that these exposures are five levels below our lowest stoping and three levels below our lowest development on 10 level, the results may be regarded as most encouraging.

At the Sunace and Bay Horse Mines the estimated working profits for the five months were £934 and £1,663 respectively.

PROFIT AND DIVIDEND

The working profit for the three mines for the period was thus £46,983, excluding additional revenue which will accrue from the sales of gold at prices in excess of 245/6d. per ounce for the months of January and February, 1956.

On March 8 Dividend No. 5 of 4½d. per share, equivalent to 7½%, was declared payable to shareholders registered on March 29, 1956. This is the same as declared in March, 1955. It is expected that dividend warrants will be posted on or about May 9, 1956.

I now move that the Directors' Report and Accounts for the year ended Setpember 30, 1955, as submitted at this meeting, be approved and adopted and that all matters and things undertaken and discharged by the Directors on behalf of the Company be, and they are hereby, confirmed.

The resolution was carried.

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A RECORD YEAR

The eighth annual general meeting of Hilger and Watts Limited was held on March 27 in London.

Mr. G. A. Whipple, M.A., M.I.E.E. (Chairman and Managing Director) presided and, in the course of his speech, said: Sales for the year under review showed an increase of 15 per cent. the highest yet achieved by your Company. The Trading Surplus for the year was £209,900, an increase of £28,186. The Profit did not improve quite as much as turnover owing to our endeavours to avoid price increases despite the rising costs of wages and materials. Profits before Taxation rose by £24,395 to £124,194 on which sum we have provided for Profits Tax and Income Tax at £69,145.

The Company's Net Current Assets are greater than the total Issued Capital by £199,982.

The Pilot Unit of our New Factory at Debden is now in full production, and has made in this year a substantial contribution to our output. Despite this, our capacity for delivery lags behind our ever increasing rate of receipt of Orders. The main obstacles in achieving a balance between Orders and Sales are shortage of skilled labour and of factory space equipped with the necessary machine tools.

We have taken action on both counts. On the first an intensified scheme for training apprentices, which was instituted in 1950 should shortly be bearing fruit. Secondly, extensions have been put in hand at our Debden factory, where a new Block is under construction. On the termination of the tenancy of a part of the Camberwell Premises, Sales and Administrative Departments will move into extensions to the Company's Offices at Camden Town.

About half our production is directly exported and we know also that units which we supply to firms in this country are built into their own equipment and eventually sold overseas. Despite the high rate of Import Duty more than one-seventh of our exports goes to the United States of America. This I think is a very fine tribute to the quality of our instruments.

The progress of so many of our new projects and the continued demand for our Traditional instruments gives me full confidence in the future.

The report was adopted and the Ordinary dividend of 10% was approved.

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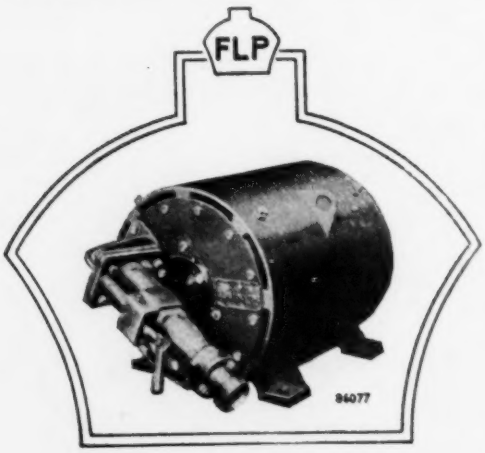

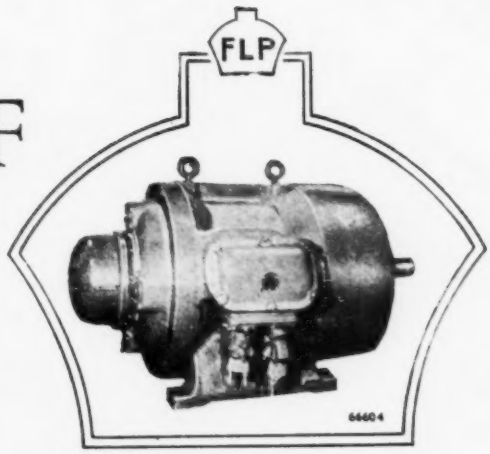

Top Left: *Totally-enclosed fan-cooled flameproof squirrel-cage motor, type KF.*
Top Right: *T.E.F.C. flameproof slipring motor, type FW.*

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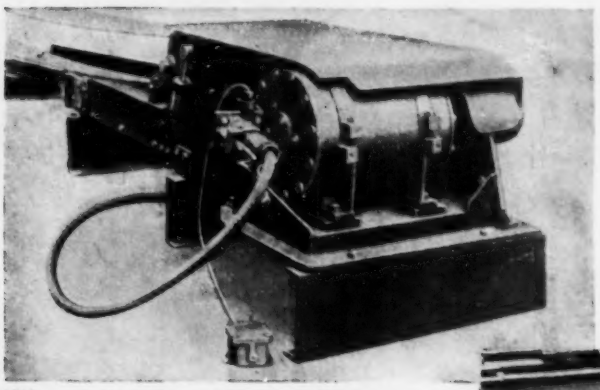

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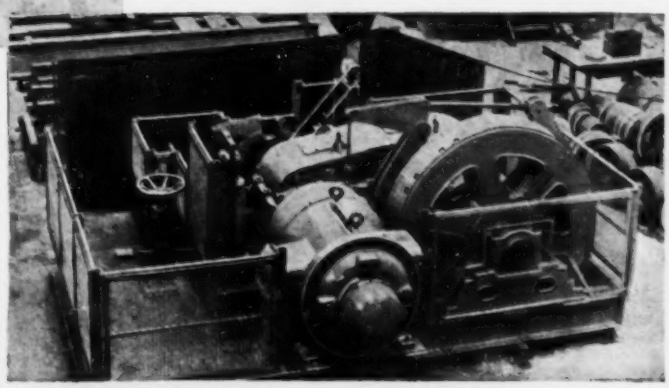

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